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Fiscal Policy Uncertainty and Economic Activities in Iran's Provinces

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Abstract:

The positive impacts of fiscal policy could be undermined when accompanied by uncertainty. We examined the effect of fiscal policy uncertainty on economic activities in the provinces of Iran. It includes production, investment, unemployment, and economic participation of the active workforce in these provinces, taking into account the effects of economic sanctions imposed on the economy. We employed two types of shocks: fiscal level shock (representing fiscal policy) and its volatility shock (as fiscal policy uncertainty), which derived from a specified fiscal reaction function. We estimated a Panel VAR model using provincial data from 2003 to 2020. The results of the impulse response function indicated that following the impulse in the fiscal policy uncertainty, the response shows an increase in the unemployment rate in the short run, a decrease in the capital investment, and an increase in the inflation rate in the short and medium terms. In the medium and long term, the response indicates a decrease in GDP growth and a reduction in the economic participation rate of the active workforce.

1. Introduction

Over the last half century, the fiscal policy shocks in Iran's economy primarily emanated from the oil price shock and financial sanctions.

Achieving desired economic growth in the development plans in Iran required investment; however, the volatility of financial resources led to the instability of fiscal policy. Also, the intensification of financial and economic sanctions since 2011 adversely affected the stability of fiscal policy to achieve target investment and output (Mirjalili, 2022, pp.31-34). As a matter of fact, Iran's economy has

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been trapped in the middle-income level over the last five decades. Enhancing investment helps escaping the middle-income trap in Iran. By investing in the skills needed to work in the R&D activities and capability, Iran can produce high-quality products with these measures (Mirjalili and Saadat, 2020, p.10). Since 2021, Iran has downgraded to a lower middle-income level due to fiscal and exchange rate shocks.

Moreover, uncertainty of government budget revenues was realized through the impact of oil revenue fluctuation due to sanctions. As the government budget is highly dependent on the oil revenue, external shocks such as the intensification of economic sanctions since 2012 have led to a decrease and volatility in the oil revenue and left the budget imbalanced. Subsequently, the government budget deficit happened, and we have witnessed a decrease in the foreign exchange revenues and economic growth (Heydarian et al., 2021).

Also, the intensification of financial sanctions against Iran in the 2010s led to a reduction in the import of capital and intermediary goods, which adversely affected investment and output in Iran (Heydarian et al., 2023). As a result, it significantly increased the costs of aggregate supply for the economy.

After the intensification of economic and financial sanctions in the 2010s and increasing budget deficit since 2012, followed by a decrease in output. During this period, Iran's economy was faced with more sanctions, in which the direct effect of the sanctions on investment was negative. Various aspects of the negative impact of sanctions on Iran's economy have also been shown in Mirjalili's review (2021). The government played its economic role through fiscal policy. However, when fiscal policy is accompanied by uncertainty, the positive effects of fiscal policy are undermined. As illustrated in Figure (1), in 2012, the intensification of sanctions led to an increase in the fiscal policy uncertainty in Iran. From 2013 to 2016, the fiscal policy uncertainty index showed a very mild downward trend. However, since 2017, the fiscal policy uncertainty index has been rapidly rising, reaching its peak in 2020, a level that Iran's economy had not experienced since 1979 (Safari et al., 2023).

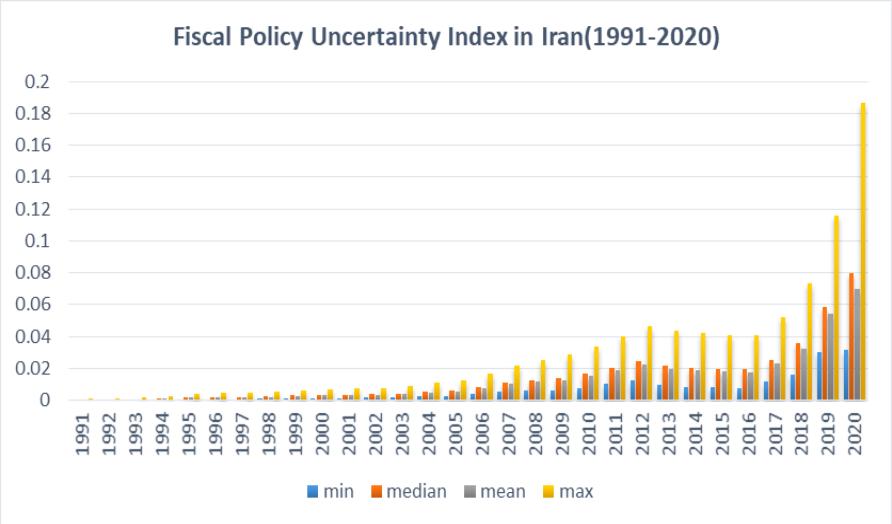

Figure (1): Fiscal Policy Uncertainty Index in Iran

Source: safari et al (2023)

It is worth mentioning that in this paper, we employed the fiscal policy uncertainty index for Iran, measured by Safari et al. (2023), which is derived from the specified fiscal reaction function. As the function is influenced by two types of shocks- fiscal level shock and fiscal instability shock (which serves as an approximation for fiscal policy uncertainty) - it is estimated using the particle filter method with MATLAB coding, rather than the GARCH method.

This is in contrast to most previous studies in Iran, which conducted the GARCH method. These studies did not differentiate between fiscal level shock and fiscal instability shock and treated both shocks together as a proxy for fiscal policy uncertainty. However, Fernandez-Villaverde et al. (2015), Anzuini et al. (2020), Popiel (2020), and Safari et al. (2023, 2024) highlighted the limitations of using the GARCH method, as it lacks the ability to distinguish between these two shocks. They argue that the fiscal instability shock serves only as a proxy for fiscal policy uncertainty.

In this specified fiscal reaction function, the dependent variable is the cyclically adjusted budget balance, also known as the structural budget balance of Iran. As depicted in Figure 2, the trend of the overall budget aligns with the trend of the structural budget balance in Iran, indicating that the nature of Iran's government budget is structural and that discretionary budget decisions by the government have increased during the period of intensified sanctions.

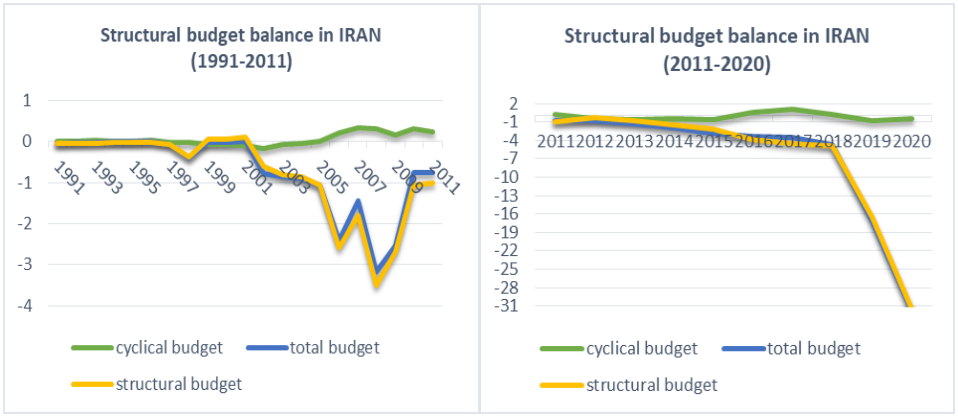

Figure (2): Total, Structural, and Cyclical Budget Balance in Iran

Source: safari et al (2023); structural budget balance, total budget balance, and cyclical budget balance as a percent of GDP.

The effectiveness and efficiency of fiscal policy shocks can differ not only across countries but also within a country over time. One important reason for this is the level of uncertainty embedded in fiscal policy shocks (Anzuini et al., 2020), which can lead to undesirable and inefficient fiscal policy outcomes. In fact, fiscal policies are often accompanied by uncertainty, and the degree of uncertainty—whether high or low—affects the efficiency of fiscal policy. When an economy faces a substantial shock of uncertainty in the short term, the effectiveness of fiscal policy on output can be reduced by up to three-quarters (Bloom, 2014).

Economic theory suggests that uncertainty shocks can be important in explaining economic fluctuations. In the face of increasing uncertainty, firms tend to delay their hiring and investment plans and respond more by adjusting their workforce and reducing investment (Bloom, 2014). The adverse effects of fiscal policy uncertainty can arise from lower employment, reduced investment by firms, and higher financing costs (Beckmann and Czudaj, 2020).

Of course, the macroeconomic effects of fiscal policy are an economic issue on which New Keynesian economists generally agree. Therefore, the effects of fiscal policy are based on New Keynesian assumptions about the effectiveness of fiscal policy and that fiscal policy drivers can lead to macroeconomic outcomes (Mirjalili, 2015: 448).

Thus, the paper aims to examine the effect of fiscal policy uncertainty on economic activities in Iran's provinces, including production, investment, the unemployment rate (or employment), and the economic participation of the active workforce in the provinces, considering the situation under sanctions.

In Safari et al. (2024), the impact of fiscal policy uncertainty on investment in 24 industrial groups in Iran was examined using a dynamic panel model and the generalized method of moments. However, in that study, the impact of fiscal policy uncertainty was only examined in terms of investment in 24 industrial groups. In contrast, this paper addresses not only investment but also production, unemployment rate, and economic participation rate, while also covering the provincial level, with a detailed breakdown of all 30 provinces in Iran.

This paper is organized as follows: After the introduction, section 2 explains the theoretical background. Section 3 provides the empirical literature review, and Section 4 provides the model and data. Section 5 is devoted to model estimation and the findings, and Section 6 concludes.

2. Theoretical background

In economics, uncertainty is distinct from risk. Risk refers to the likelihood of achieving the expected cash flow (or rate of return), where the outcome is unknown, but the probability distribution of that outcome is known. In contrast, uncertainty involves both an unpredictable outcome and an unknown probability distribution (de Groot and Thurik, 2018).

Uncertainty arises from a lack of knowledge and information. Neoclassical economics assumes that investors act rationally, using their experience and theoretical knowledge when making decisions. However, in uncertain conditions with insufficient information, investors may act irrationally, as seen in behaviors like herding after an unusual event in the capital market (Jackson and Orr, 2019).

Investors are forced to make decisions under uncertainty, and all investments carry an element of uncertainty. The level of uncertainty can vary, and Hargitay and Yu (1993) describe this as a "spectrum of uncertainty," where absolute certainty, representing risk-free cash flows, marks the lowest level of uncertainty. The highest level, perfect uncertainty, aligns with what economists refer to as Knightian uncertainty.

Investors, businesses, and those affected by policy changes often become anxious about shifts in the economic landscape, especially when these policy changes may be reversed. This leads to behaviors that Rodrik (1991) identifies as rational, such as delaying spending, investment, and expansion to minimize the uncertainty following a policy shift. When high policy uncertainty causes delays in private investment, it can significantly slow investment growth and even halt economic progress (Jackson and Orr, 2019).

Justiniano and Giorgio (2008) argue that the reduction in volatility from U.S. investment shocks played a key role in decreasing GDP growth volatility over the two decades leading up to 2004. According to Rodrik (1991), in addition to individual and business-level effects, broader consequences may be felt in areas like imports, exports, exchange rates, savings, and even sociopolitical stability.

The longer and more contentious the policy-making process, the greater the uncertainty and its impacts (Bloom, 2009). This paper focuses specifically on the uncertainty surrounding fiscal policy, which can create uncertainty for economic actors for several reasons (Anzuini and Rossi, 2020).

The fiscal policy includes the government finances (tax decisions, decisions about oil revenues in oil-exporting countries), government spending, and the response of fiscal policy to the business cycle—such as the output gap, unemployment rate, and public debt structure, which directly affects businesses. Therefore, an increase in fiscal policy uncertainty passes-through the real economy (Safari et al., 2024).

New Keynesian economists agree that fiscal policy affects the real economy. Therefore, the effects of fiscal policy are based on new Keynesian assumptions about the effectiveness of fiscal policy shocks, and that fiscal policy stimulants can lead to macroeconomic outcomes (Mirjalili, 2015: 448).

The effectiveness and efficiency of fiscal policy shocks can have different effects not only in different economies but also within the same economy at different times. One important reason for this could be the level of uncertainty embedded in the fiscal policy shock itself (Anzuini et al., 2020), which can lead to undesirable effectiveness and inefficiency in fiscal policy. In fact, government fiscal policy is occasionally accompanying by uncertainty, and depending on the level of high or low uncertainty in fiscal policy, it impacts the efficiency of the policy. When the economy faces a substantial uncertainty shock in the short run, the effectiveness of fiscal policy on production decreases by three-quarters (Bloom, 2014).

In economic theory, uncertainty shocks play a significant role in explaining economic fluctuations. Firms may respond to a more uncertain environment by adjusting their workforce and reducing investment, financial intermediaries might become more hesitant to lend, and households may increase their saving behavior (Bloom, 2014).

The negative effects of fiscal policy uncertainty can result from decreased hiring and investment by firms, higher financing costs due to risk premiums, and reduced consumption due to precautionary savings (Beckmann and Czudaj, 2020).

According to Francisco et al. (2012), in countries where public finance is unstable, households and firms may anticipate changes in tax rates or government spending plans, affecting key variables such as net profit and disposable income. However, they may remain uncertain about the timing and magnitude of these changes.

Even in countries with stable public finances, fiscal policy uncertainty may increase if the policy process is polarized or if fiscal frameworks are weak (Kontopoulos and Perotti, 2002).

In such countries, policy uncertainty leads to fiscal policy uncertainty because changes in government or political coalitions can result in unpredictable or irregular shifts in fiscal policy. Even in stable, solvent countries with sound fiscal frameworks, policy uncertainty shocks from unexpected events can still disrupt economic activity, leading to slower growth and higher unemployment by encouraging precautionary savings and delaying investment.

3. Empirical literature review

Abbasiyan et al. (2006) examined the effect of tax uncertainty on employment in economic sectors in Iran using an OLS model. The GARCH method is employed to estimate uncertainty. The results suggest that uncertainty in fiscal policies—specifically tax policies— adversely affects industrial, services, and agricultural sectors.

Mirjalili et al. (2009) explored production, investment, unemployment, and economic participation at the provincial level. They employed a synthesis of factor analysis and numerical taxonomy for two-digit ISIC codes to derive investment, production, and employment priorities. The results indicated the non-metallic mineral products and textiles. However, the production of basic metals and chemicals had a rapid growth but has been neglected in investment plans at the provincial level (Mirjallili et al. 2009).

Suri et al. (2011) explored the impact of uncertainty in government consumption expenditures on economic growth in Iran over the period of 1965-2000. The GARCH method is used for uncertainty estimation. The results suggest that the unstable component (uncertainty index) in the share of government consumption expenditures has an adverse impact on investment, while its stable component has a positive impact on investment. Furthermore, the growth rate of non-oil GDP, when uncertainty exists in government consumption expenditures, was around 5.1%, but without uncertainty in government expenditures, it could have risen to about 9.5%. Therefore, uncertainty in government consumption expenditures has led to a significant reduction in economic growth through decreased investment.

Fernandez-Villaverde et al (2015) examined the effect of fiscal policy uncertainty (government tax revenue and spending uncertainty) on economic activity in the United States over the period of 1970–2014 on a quarterly basis, using both VAR and DSGE models. He clearly distinguishes between fiscal shocks and fiscal volatility shocks. The key determinant of the fiscal policy uncertainty index is a fiscal response function that utilizes several budgetary variables (government spending, taxes, government debt, and output). To estimate uncertainty, due to the time-varying instability of shocks, or in other words, the stochastic volatility, he employed a particle filter estimation method with MATLAB coding. The results suggest that following a fiscal volatility shock, U.S. output, investment,

hours worked, the federal funds rate, and real wages significantly decrease, while inflation and markups increase. A key point to highlight is that the majority of production reductions stem from a decline in investment, as observed in both the VAR model and the New Keynesian DSGE model. Among the variables discussed, investment has the most detrimental impact on fiscal instability shocks in both models.

Ricco et al. (2016) examined how fiscal policy communication influences the propagation of government expenditure shocks by assessing an index of coordination impacts on private agents' expectations in the U.S. from 1981 to 2012. Using expectational threshold VAR and Bayesian techniques, their findings suggest that during periods of low uncertainty (when there is little disagreement about future government expenditures), investment reacts more strongly, leading to more pronounced fiscal policy effects. Conversely, during periods of high uncertainty (when there is greater disagreement about government fiscal policy), the investment response to fiscal policy shocks is diminished.

Akbarzadeh et al. (2018) explored the investment and growth constraints in Iran's economy between 2001 and 2016 using Hausman, Rodrik, and Velasco (HRV) and grounded theory methods. Their findings, based on the growth diagnostics decision tree, identified weaknesses in investment financing as the primary constraint on investment, entrepreneurship, and growth in Iran. Additionally, deficiencies in the stable operation of fiscal policy, particularly government capital expenditures, contributed to this bottleneck.

Bagherzadeh et al. (2020) investigated the effect of government economic policy uncertainty on economic growth in Iran during the period of 1979-2018 using the Generalized Autoregressive Score model for uncertainty estimation. The results indicated that in the low investment level, the adverse effect of government expenditure uncertainty on economic growth was neutralized by the development of capital markets. In contrast, at the high investment level, the adverse effect of government expenditure uncertainty on economic growth persists even with the development of capital markets.

Beckmann and Czudaj (2020) examined the effect of fiscal policy uncertainty on Germany's unemployment rate, production growth, and industrial production using the VAR and Bayesian-TVP-VAR-Stochastic Volatility model. Based on endogenous variables, which include the fiscal policy uncertainty measure, the unemployment rate, and the year-on-year growth rate of industrial production and GDP. The study spans the period from November 1995 to April 2018 on a monthly basis. The determining factor for the fiscal policy uncertainty (FPU) index is the disagreement in expert predictions regarding the future budget balance for the German economy. The results suggest that an increase in FPU adversely affects industrial production growth in Germany, with a statistically

significant effect lasting more than 7 months. The strongest reaction to the shock occurs after five months, and it reduces the annual industrial production growth rate by more than 0.8 percentage points. The effect of fiscal policy uncertainty on the unemployment rate in Germany is increasing but insignificant. One reason for the insignificance of the FPU shock on unemployment might be the rigidity of the German labor market in the short run.

Anzuini et al. (2020) examined the effect of level fiscal shock and volatility shock (Fiscal Policy Uncertainty) on Italy's GDP, employment, and private GDP deflator using a VAR model over the period from January 1981 to March 2014 on a monthly basis. The determinant for the fiscal policy uncertainty index is a fiscal reaction function, where they used the adjusted structural primary budget balance. To estimate uncertainty, they employed a particle filter estimation with MATLAB coding. The results suggest that the two fiscal shocks have an opposite impact on economic activity: GDP and employment increase after a level shock (fiscal expansion) and decrease after a volatility shock (FPU increases).

Heydarian et al. (2021) analyzed the effect of financial sanctions on fiscal policy, investment, and economic growth by employing an intervention time-series analysis over the period of 2005-2017. These sanctions targeted the government's oil revenues and increased financing costs. They negatively impacted the government's fiscal position, creating uncertainty around the investment budget, which led to a budget deficit and slower growth. The freezing of assets and limited access to foreign exchange resources led to reduced investment and production, ultimately slowing economic growth. The results showed a short-term negative impact of financial sanctions on the government's investment budget and economic growth. However, over the period from 2010 to 2014, when severe and multilateral sanctions were imposed, both investment and economic growth significantly slowed down. In contrast, in the long run, the impact of these sanctions on investment and economic growth was less severe.

Mirjalili and Karimzadeh (2021) explored how the resources of Iran's National Development Fund (NDF) could be used as a fiscal policy tool to mitigate the fluctuations and uncertainties in fiscal policy. To reduce the volatility caused by fluctuating oil prices, the sovereign wealth fund could play a crucial role in stabilizing investment and output. Using a DSGE model, they tested various scenarios for managing NDF resources to lessen fiscal policy volatility. One scenario involved depositing all oil revenues into the NDF, with a portion of the fund—equivalent to the interest rate in OECD countries plus 70% of long-term oil revenues—being invested into the economy as a stabilizing measure.

Kasal and Tosunoglu (2022) examined the effect of fiscal policy uncertainty on output, investment, and exchange rates in Turkey over the period from 1998 to 2020 on a quarterly basis. The determinant for the fiscal policy uncertainty index is a fiscal reaction function in which the structurally adjusted primary budget

balance is used. However, they do not differentiate between the fiscal level shock and the financial instability shock, instead introducing both shocks under one shock, named the FPU index for Turkey. Therefore, they used the GARCH method to estimate uncertainty. The results indicated that, in the Turkish economy, the FPU shock has a significant negative effect on output for the first two quarters (about −0.75%). The FPU shock leads to a significant negative effect on investment for only one quarter (about −1.5%). The decline in output is smaller compared to the decline in investment.

Marioli et al. (2023) examined fluctuations in fiscal policy across a broad range of countries, with particular emphasis on emerging market and developing economies, as well as commodity exporters, between 1990 and 2021. Their findings revealed that fiscal policy has been more volatile in emerging markets and developing economies compared to advanced economies and in commodity exporters compared to non-commodity exporters. The study highlighted the negative macroeconomic impact of these fluctuations on economic growth. Over a 30-year period, these fiscal policy variations account for 8% of the income disparity between emerging markets and developing economies and advanced economies.

Gudarzi and Abbasinejad (2023) examined the effect of economic policy uncertainty on macroeconomic variables over the period from 1991 to 2022. For modeling economic policy uncertainty, they employed the index introduced by Baker et al. (2016). The results suggest that a shock to fiscal policy uncertainty causes positive reactions in the inflation rate, interest rates, government spending, and output deviations. However, other variables such as employment and taxes show a negative reaction.

Hong et al. (2024) explored the effect of global fiscal policy uncertainty on industrial production in both advanced and emerging market economies using a panel VAR model on a monthly basis over the period from January 1987 to April 2023. The results suggest contractionary effects in all 189 countries with different income groups. A shock to global fiscal policy uncertainty leads to a reduction in industrial production in both advanced and emerging market economies. In both groups, industrial production declines by approximately 6% about 5 months after the shock, with more persistent negative effects in advanced economies (except for the US), which last for up to 20 months.

Heydarian et al. (2024, 2025) explored the impact of financial sanctions on the volatility of oil revenues, exchange rate fluctuations, macroeconomic variables, and fiscal policy in Iran using a DSGE model. The results indicated that the production, and private sector investment indicated a negative reaction to the oil revenues' shock.

Safari et al. (2024) examined the impact of fiscal policy uncertainty on industrial investment in Iran using a dynamic panel model and GMM across 24 industrial

sectors in Iran over the period from 2002 to 2020. The determinant of the fiscal policy uncertainty index is a financial reaction function in which the structurally adjusted initial budget balance is used. To estimate the uncertainty, they have used a particle filter estimation with coding in MATLAB software.

The results indicated that the growth of fiscal level shock had a direct, though small, positive effect on investment. However, the interaction between the growth of fiscal level shock and fiscal policy uncertainty weakened this positive effect on investment. The government influenced industrial investment in two indirect ways through demand-side shocks. First, by stimulating demand, it positively impacted industrial investment through the interaction between fiscal level shock growth and industrial sales. On the other hand, the growth of fiscal level shock also led to increased fiscal policy uncertainty, and the interaction between fiscal policy uncertainty and the growth of industrial sales had a significant negative impact on industrial investment. These findings indicated that due to high uncertainty, the indirect government effect on investment across 24 industrial sectors is negative, operating through the demand-side shock.

HajiMollaMirzaee et al. (2024) examined the effect of fiscal (expenditure) uncertainty on economic activities over the period 1986- 2020 using the SVAR model. Also, the uncertainty of current and capital expenditures is measured using the GARCH method. Their results indicated that an oil shock leads to a 5% increase in output and a 1% increase in employment. Additionally, a financial crisis shock leads to a 3% decrease in output and a 12% decrease in employment. A shock to the uncertainty of current and capital expenditures leads to a 12% reduction in output and a 7% and 5% reduction in employment, respectively.

Our contributions: The contributions and distinctions of this paper are as follows: First, it considers both tools of fiscal policy, including government tax revenue, especially after the intensification of financial sanctions in the 2010s, when the share of oil revenues in the total government budget significantly decreased, and the share of tax revenues in the total government budget significantly increased. Therefore, it is necessary to consider the uncertainty of tax revenues, which directly impacts investment and production decisions. This is addressed in the paper by the overall balance or budget deficit and extracting its uncertainty. Second, while most studies in Iran did not distinguish between financial level shocks and financial instability shocks, treating both as a proxy for fiscal policy uncertainty and estimating them using the GARCH method, the critical assessment by Fernandez-Villaverde et al. (2015), Anzuini et al. (2020), Popiel (2020), and Safari et al. (2023, 2024) indicated that the GARCH method lacks the ability to distinguish between these two shocks, whereas only the fiscal instability shock serves as a proxy for fiscal policy uncertainty. Third, the intensification of sanctions in the 2010s is accounted for in the model. Fourth, the level of the research is provincial and covers all provinces of Iran. Fifth, a related

study is that of Safari et al. (2024), which examined the effect of fiscal policy uncertainty on investment in 24 industrial groups, while this paper examines the uncertainty's impact on investment, output, unemployment rate, and economic participation rate. Moreover, the research is conducted on 30 provinces in Iran and not on 24 industrial groups.

4. Model and data

Model: In line with theoretical and empirical foundations, to quantitatively examine the effect of fiscal policy uncertainty on economic activities in Iran, we employed the basic econometric model of Anzuini et al. (2020). Additionally, the econometric models of Beckmann and Czudaj (2020) and Hong et al. (2024) also support the econometric model of this research.

What distinguishes Iran's economy is the sanctions, particularly after the intensification of financial sanctions on Iran since 2012, which must be incorporated into the econometric models for Iran (Heydarian et al., 2021, 2022). Therefore, the sanction conditions of Iran's economy are incorporated into the model as an exogenous variable.

$$Y_{it} = c_i + \tau_t + A(L)Y_{i(t-1)} + B(L)\chi_t + C(L)\mu_t + sanction_t + \nu_t$$

Where Y_{it} is an N × 1 matrix of endogenous variables that include the growth of non-oil GDP for the provinces of Iran, investment growth, unemployment rate, economic participation rate, and inflation rate in the provinces. The variables χ_t و μ_t are Fiscal level Shock and Fiscal Policy Uncertainty shock respectively. c_i and τ_t denote cross-section and time fixed effects. Cross sections are indexed by i = 1, 2, .., 30. While the time dimension is indexed by t = 2002, 2003, .., 2020. A(L) is a polynomial matrix in the lag operator, and B(L) and C(L) are finite-order polynomials in the lag operator L. Finally, t is a time trend, and ν_t is the residual of specification error.

Data: The data sources employed in the model are presented in Table (1). The data sources are the statistical yearbooks of the provinces from the Statistical Center of Iran.

Table 1: Sources of data for the Panel VAR

Variable	Definition and Source of Data
growth of non-oil GDP for the provinces of Iran	The growth of non-oil GDP for the provinces of Iran has been adjusted using the Consumer Price Index in urban areas of Iran (with base year prices of 2016). The data is extracted from the National Accounts - Regional Accounts of the Statistical Center of Iran. It is important to note that the most recent year with detailed provincial production data available at the time of conducting this research is up to 2019, even in the provincial statistical yearbooks for all 30 provinces (from the latest published yearbook for 2022).
Investment Growth in the Provinces of Iran	Investment data for each province are not available. As in other studies, data on the performance of provincial capital expenditures are used as a proxy, expressed as a percentage of the share of the GDP of each province.
Unemployment rate and economic	The economic participation rate (according to the definition of the Statistical Center of Iran) is the ratio of the active population (employed and unemployed) aged 10 and

participation rate in the provinces of Iran	older to the total working-age population (aged 10 and older). The unemployment rate is the ratio of the unemployed population to the active population (employed and unemployed). The data for both are sourced from the Human Resources data section of the provincial statistical yearbooks from the Statistical Center of Iran.
Inflation rate in the provinces of Iran	Calculation is done using the Consumer Price Index in urban areas of Iran (with base prices of 2016), and the data source is the Statistical Center of Iran.
Fiscal level shock, Iran's Fiscal Policy Uncertainty index	Extracted from the calculation of Safari et al. (2023) by coding in MATLAB software.
financial sanction	Considered as a dummy variable until 2011 with a value of zero, and from 2012 with a value of one.

The summary of the data is provided in table (2).

Table 2. Variables and Descriptive statistics

Variables	Acronym in Impulse Response Function	Observation	Max	Min	Mean	Median	Standard Deviation
Growth of non-oil GDP of the provinces in Iran	$GGDP_2$	558	0.60	-0.312	0.0596	0.0583	0.0889
Investment Growth in the provinces of Iran	GI_1	558	5.90	-0.902	-0.0104	-0.0952	0.5780
Unemployment rate in the provinces of Iran	U_1	525	22.20	4.1	11.375	11.1	2.898
Economic participation rate in the provinces	U_2	525	49.10	26.1	38.7874	38.60	3.823
Inflation rate in the provinces of Iran	INFLATION	558	46.70	2.07	19.5011	16.0	9.8440
Growth of Fiscal level Shock	GFLSH	558	3.2586	-3.9127	-0.6671	-0.2425	1.7657
Growth of Fiscal Policy Uncertainty shock	$GFPU_1$	558	0.6489	-0.1200	0.2005	0.1936	0.1830

Source: Authors' findings

5. Model Estimation and the Findings

To examine the stationarity of the variables, we employed the Fisher unit root test based on the Augmented Dickey-Fuller test and the Im-Pesaran-Shin test. The results of the unit root tests for the variables are presented in Table 3. The null hypothesis assumes the existence of a unit root for the variable.

Table 3: Unit Root Test

Variables	Im, Pesaran, and Shin (IPS) Unit Root Test		Fisher-based ADF Unit Root Test		Result I (0)	Result I (1)
	include intercept and time trend	include intercept	include intercept and time trend	include intercept		
Growth of GDP excluding oil for the provinces of Iran	-18.2487*** (0.0000)	-8.94514*** (0.0000)	-2.86320** (0.0021)	-8.66180*** (0.0000)	Reject H_0	
Growth of Fiscal level Shock	-8.40801*** (0.0000)	-11.6434*** (0.0000)	-8.34887 *** (0.0000)	-11.2592 *** (0.0000)	Reject H_0	
Growth of Fiscal Policy Uncertainty shock	2.25898 *** (0.9881) -8.61379 *** (0.0000)	-1.65820 ** (0.0486) -12.6361 *** (0.0000)	2.29997 ** (0.9893) -8.50448 *** (0.0000)	-1.87352 ** (0.0305)	Fail to reject H_0	Reject H_0
Growth of Investment in Provinces (as a fraction of GDP)	-18.4173 *** (0.0000)	-17.9971 *** (0.0000)	-14.9611 *** (0.0000)	-15.1753 *** (0.0000)	Reject H_0	
Unemployment Rate in Provinces	-0.20860 *** (0.4174) -5.28130 *** (0.0000)	-1.77228 *** (0.0382)	-0.34088 *** (0.3666) -5.77933 *** (0.0000)	-1.93035 *** (0.0268)	Fail to reject H_0	Reject H_0
Economic Participation Rate in Provinces	3.14980*** (0.9992) -8.38443*** (0.0000)	1.34922*** (0.9114) -7.84704*** (0.0000)	3.54692*** (0.9998) -8.20817*** (0.0000)	1.37814** (0.9159) -7.94204*** (0.0000)	Fail to reject H_0	Reject H_0
Inflation Rate in Provinces	-5.45093*** (0.0000)	-7.81418*** (0.0000)	-5.93476*** (0.0000)	-8.13996*** (0.0000)	Reject H_0	

Notes:

- **Reject H_0** indicates that the null hypothesis (existence of a unit root) is rejected.
- **Fail to reject H_0** indicates that the null hypothesis (existence of a unit root) is not rejected.
- **Values in parentheses** represent p-values.
- The asterisks **(*), (**)** and **(***)** represent statistical significance levels, with (0.0000)*** indicating a highly significant result.

As indicated in the results of Table 3, for 4 variables, considering both the constant term (intercept), with and without a time trend, they became stationary at the level. However, for the other 3 variables, stationarity was achieved after taking the first difference.

Determining the Optimal Lag Length for the Model: To estimate the model, it is first necessary to determine the optimal order of the model using criteria for selecting the lag length in the vector autoregression model. Table 4 presents the optimal lag length based on various criteria for selecting the optimal lag length for the chosen model.

Table 4: Determining the Optimal Lag Length for the Model

Statistics / Lag	HQ	SC	AIC
0	20.64956	20.73378	20.59434
1	15.93073	16.30975	15.68227
2	13.98172	14.65552	13.54000
3	13.08843	14.05702	12.45346
4	11.34310*	12.60648*	10.51488*

Source: Authors' findings

According to the results in the above Table 4 and based on the Akaike information criterion and Schwarz Hannan-Quinn the fourth lag is chosen.

Stability condition test for the model: After determining the optimal lag, estimations were conducted for the model. Figure 3 displays the stability (eigenvalue) results of the model. The model stability test refers to the condition that the model is invertible and includes an infinite number of moving average vectors, which can be used for interpreting impulse response functions and variance decomposition. As the eigenvalues of this model are less than one, and the roots of the companion matrix lie inside the unit circle, the stability condition in the Panel VAR model is satisfied.

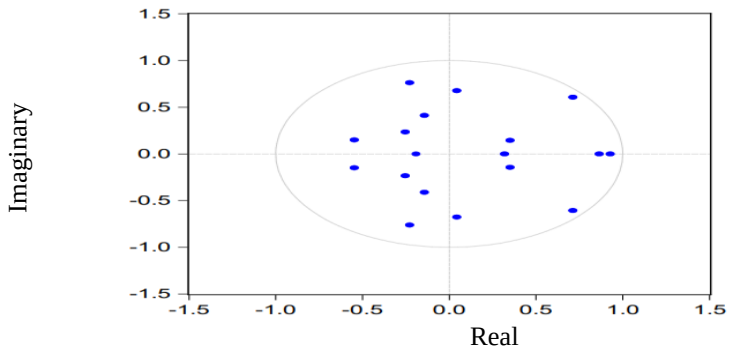

Figure 3: Stability condition test
Roots of the companion matrix

Source: Authors' findings

Cointegration Test: Before estimating the model, the existence of a long-term relationship between the variables in the study is examined using the cointegration test. To assess long-term equilibrium relationships between multiple economic variables in the panel model, we employed the Kao cointegration test. In this test, the null hypothesis assumes the absence of cointegration between the variables. The results of the Kao cointegration test are depicted in Table 4, which indicates that the null hypothesis of no cointegration

between the variables cannot be accepted. Therefore, there is a significant long-term relationship between the variables mentioned in the model.

Table 4: Kao Cointegration Test

	t-statistic (Prob)	result
ADF	-3.377716 0.0004	existence of cointegration vector

Source: Authors' findings

As indicated in Table 4 (Kao), a long-term relationship exists between the variables in the study. However, we did not rely solely on the Kao test and for further assurance, we utilized the Pedroni test. Pedroni (1999, 2004) proposed seven cointegration tests in two general groups, allowing for different intercepts and time trend coefficients across individual units. The results are presented in Table 5.

Table 5: Pedroni Cointegration Test

Statistics	with intercept and time trend	with intercept
Panel v-Statistic	-5.617198 (1.0000)	-3.264726 (0.9995)
Panel rho-Statistic	4.935857 (1.0000)	3.090281 (0.9990)
Panel PP-Statistic	-19.18394 (0.0000)	-16.48380 (0.0000)
Panel ADF-Statistic	-14.25196 (0.0000)	-12.57379 (0.0000)
Group rho-Statistic	6.797403 (1.0000)	5.096381 (1.0000)
Group PP-Statistic	21.06441 (0.0000)	-18.35833 (0.0000)
Group ADF-Statistic	-13.26224 (0.0000)	-12.25995 (0.0000)

Source: Authors' findings

As presented in Table 5 (Pedroni), for the two cases considered, most of the reported error levels for the Pedroni statistics are below 0.05, and the null hypothesis (based on the absence of cointegration between the variables) is rejected. Therefore, it can be stated that there is a long-term relationship between the variables in the study.

The results of Impulse Response Functions: The estimated coefficients in vector autoregression (VAR) models typically do not have a direct economic interpretation. However, the derived auxiliary products (such as impulse response functions and forecast error variance decomposition) obtained after estimating the VAR model can contain important interpretations. In this regard, one of the applications of the Panel VAR model is to examine how the model variables respond to shocks occurring in each of the variables.

In this section, the shock is identified using Cholesky decomposition. The results in Figure 4 indicate a scenario where the shock from fiscal level growth (as a fiscal policy) is of one standard deviation, without any shock from the growth of fiscal policy uncertainty.

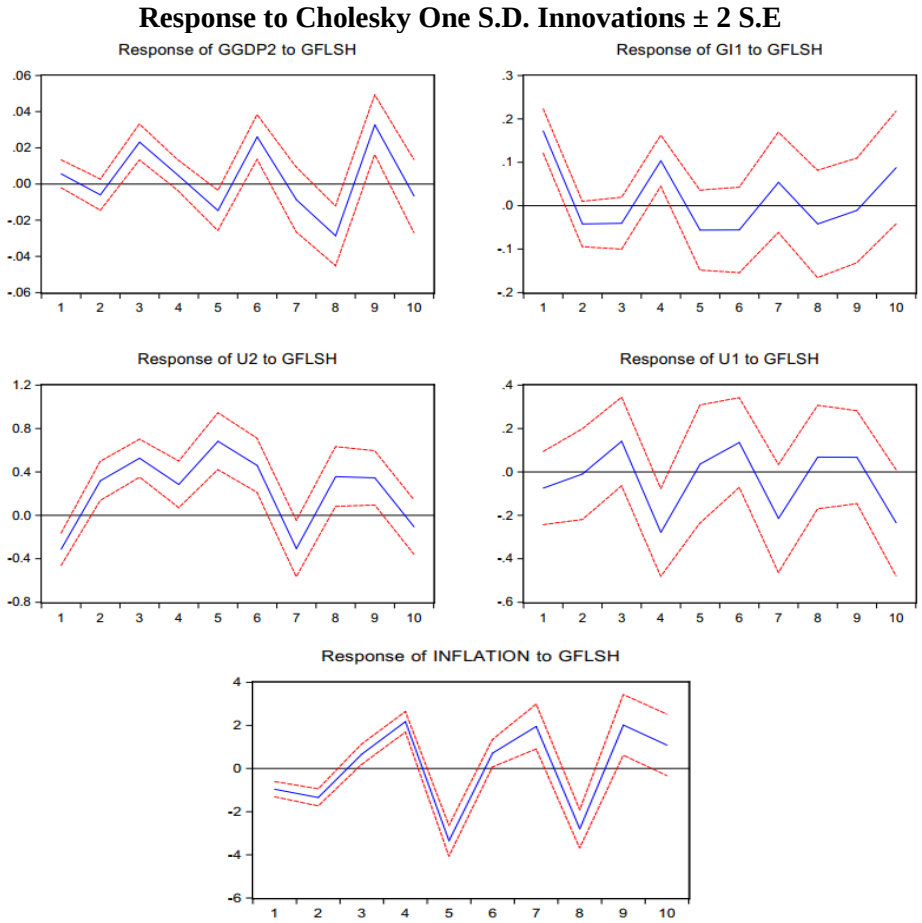

Figure 4: Impulse response functions - CAPB level shock or Growth of Fiscal Level Shock (FLSH Shock)

Source: Authors' findings

From the impulse response functions in Figure 4, it is observed that with a shock of fiscal level growth (as fiscal policy) of one standard deviation, the reaction of GDP growth in the provinces of Iran, from the start of the period to the end of period 10, although fluctuating, indicates an increasing trend.

As a result of this shock, the reaction of investment in the provinces shows a noticeable upward trend at the very beginning of the period (period 1), after

which this effect diminishes. In period 4, this positive effect is still present, but weaker than in period 1.

Additionally, it leads to an increase in the economic participation rate of the active workforce in the provinces of Iran from period 2 to the end of period 10, with the exception of period 7. Moreover, the unemployment rate indicates a very slight decrease at the beginning of the period and in periods 4, 7, and 10. Finally, this shock has a decreasing effect on the inflation rate in the provinces in the beginning of the period until period 2 and in periods 5 and 8. In contrast, it has an opposite, increasing effect on inflation in periods 4, 7, and 9. However, these results represent the effect of government fiscal policy.

What this research underscores, with its solid theoretical background, is the shock from fiscal policy uncertainty growth that accompanies fiscal policy (whether large or small). Therefore, the complementary chart, where the results of the shock from fiscal policy uncertainty growth are depicted at one standard deviation, is illustrated in Figure 5.

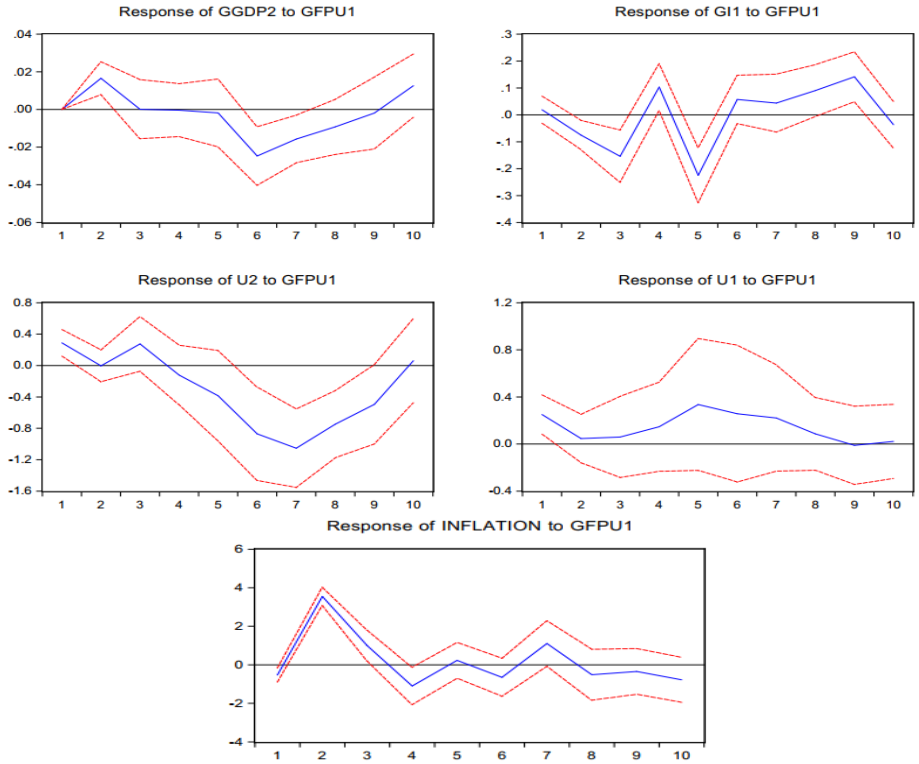

Figure 5: Impulse response functions - Growth of Fiscal Policy Uncertainty Shock (FPU Shock)

Source: Authors' findings

Interpretation of Impulse Response Functions results: From the impulse response functions in Figure 5, it is observed that with a shock from fiscal policy uncertainty growth of one standard deviation, GDP growth in the provinces of Iran shows a positive effect only in period 2. After a time lag, i.e., from period 5, the negative effect begins on GDP growth in the provinces and remains visible until period 9.

As a result of this shock, it has a negative effect on investment in the provinces, which can be seen in the first half of the entire 10 periods, i.e., in periods 2, 3, and 5. This uncertainty shock, after a time lag, leads to a significant decrease in the economic participation rate of the active workforce in the provinces, especially from period 4 to the end of period 10, with notable effects in periods 6, 7, and 8.

Furthermore, it leads to an increase in the unemployment rate, especially in the first period. Finally, this shock has an increasing effect on inflation in the provinces during periods 2 and 3, after which its negative effect diminishes. It is important to note that, according to the results in Figure 5, all the aforementioned endogenous variables converge toward equilibrium (i.e., toward zero) by the end of period 10.

From the results of the impulse response functions about the variables, the following remarks can be discussed:

i) Reaction of GDP Growth in the Provinces: With a shock from fiscal level growth, the reaction of GDP growth in the provinces of Iran shows an increasing trend, although fluctuating and low. However, with a shock from fiscal policy uncertainty growth, after a time lag, a negative effect on GDP growth in the provinces is observed. The results are consistent with the theoretical foundations and the findings of empirical studies such as Suri et al. (2011), Beckmann and Czudaj (2020), Mumtaz and Ruch (2023), Hong et al. (2024), and Kasal and Tosunoglu (2022). The outcome of these two factors indicates that, due to the high negative impact of fiscal policy uncertainty shocks in Iran on GDP growth in the provinces- especially over time and in the periods following the medium term (periods 6, 7, and 8) - this negative effect outweighs the positive effect of fiscal level shock on GDP growth in the provinces of Iran. The results are in line with the theoretical foundations and the findings of empirical studies by Fernandez-Villaverde et al (2015) and Anzuini et al. (2020).

ii) Reaction of Investment in the Provinces: With a shock from fiscal-level growth (as fiscal policy), the reaction of investment in the provinces shows a significant upward trend in period 1, but this effect diminishes afterward. However, with a shock from fiscal policy uncertainty growth, its negative effect on investment in the provinces is observed up to the medium term (until period 5). The results are consistent with the theoretical and empirical findings of Suri et al. (2011), Fernandez-Villaverde et al (2015), Kasal and Tosunoglu (2022), and

Mumtaz and Ruch (2023). Thus, the outcome of these two factors shows that only in the short term (period 1) the positive effect of fiscal policy shocks in Iran (fiscal level shock) on investment in the provinces outweighs the negative effect of fiscal policy uncertainty shocks on investment in the provinces. After this period, this relationship is completely reversed, and by the medium term, this inverse relationship and the negative effect of fiscal policy uncertainty on investment in Iran prevail.

iii) Reaction of the Economic Participation Rate of the Active Labor Force in the Provinces:

A shock from fiscal-level growth (as fiscal policy) leads to an increase in the economic participation rate of the active labor force in the provinces. However, a shock from fiscal policy uncertainty growth, after a time lag (from period 4 to period 10), exerts a negative effect, leading to a significant decrease in the economic participation rate of the active labor force in the provinces. Therefore, the result of these two effects indicates that in the short term (periods 2 and 3), the positive effect of fiscal policy shocks in Iran (fiscal level shock) on the economic participation rate of the active labor force in the provinces outweighs the negative effect of fiscal policy uncertainty shocks on the same rate. However, after the short term (from period 4), this relationship completely reverses, and we observe the dominance of the negative effect of fiscal policy uncertainty shocks on the economic participation rate of the active labor force in the provinces, overpowering the positive effect of fiscal policy shocks (fiscal level shock) on the economic participation rate of the active labor force.

iv) Reaction of the Unemployment Rate or Employment in the Provinces: A shock from fiscal-level growth (as fiscal policy) results in a slight decrease in the unemployment rate (although marginal) at the beginning of the period (and in periods 4 and 7). A shock from fiscal policy uncertainty growth leads to an increase in the unemployment rate, or in other words, a decrease in employment in the provinces, particularly in the first period. The outcome of these two effects shows that, in the same short term (the first period), the effect of fiscal policy uncertainty shocks in Iran on increasing the unemployment rate (or decreasing employment) in the provinces outweighs the positive effect of fiscal policy shocks (fiscal level shock) on reducing the unemployment rate (or increasing employment). This indicates the sensitivity and faster reaction of the unemployment rate (or employment) in the provinces to these shocks in the short-term periods. The results align with the theoretical backgrounds and findings of empirical studies by Abbasiyan et al. (2006), Beckmann and Czudaj (2020), Anzuini et al. (2020), and Gudarzi and Abbasinejad (2023).

V) Reaction of Inflation in the Provinces: A shock from fiscal-level growth (as fiscal policy) leads to both a decrease and an increase in inflation in the provinces. In the initial period until period 2 and in periods 5 and 8, there is a

deflationary effect. However, an opposite, inflationary effect on inflation in the provinces is observed in periods 4, 7, and 9. In contrast, a shock from fiscal policy uncertainty growth results in an inflationary effect in periods 2 and 3, which then diminishes. The outcome of these two shocks indicates a highly volatile and increasing inflationary situation in the provinces. In periods 2 and 3, the effect of fiscal policy uncertainty shocks on increasing inflation in the provinces dominates the effect of fiscal policy shocks (fiscal level shock) on reducing inflation. After that (from period 4 onward), as a result of these shocks, we observe an increase in inflation from the second period until the end of period 10 (except in periods 5 and 8). These results are consistent with the theoretical backgrounds and empirical findings of Fernandez-Villaverde et al (2015), Gudarzi and Abbasinejad (2023), and Mumtaz and Ruch (2023).

Variance Decomposition: While impulse response functions represent the reaction of an endogenous variable over time to a shock from another variable in the model, variance decomposition measures the contribution of each shock to the variance of an endogenous variable in the model. The results of the variance decomposition are provided in Table 6.

Table 6: Results of Variance Decomposition Growth of GDP of Provinces (GGDP2)

Period	S.E.	Growth of GDP ($GGDP_2$)	Growth of Fiscal Policy Uncertainty (GFPU)	Growth of Fiscal level Shock (GFLSH)	Growth of investment (GI_1)	Unemployment ratio (U_1)	Participation ratio (U_2)	Inflation
1	0.084047	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.085967	95.71264	2.152187	0.294017	0.814699	0.434693	0.095415	0.496349
3	0.089403	88.72366	4.270346	4.193018	0.859193	0.657906	0.689192	0.606689
4	0.093832	81.12444	8.105292	6.314545	1.604659	0.690352	0.625795	1.534919
5	0.097526	75.22503	7.614843	5.872362	3.639943	0.652903	0.719020	6.275901
6	0.103152	67.40902	7.292427	8.065392	4.996217	0.953969	2.274599	9.008376
7	0.132013	41.15915	30.73482	16.98838	3.052001	0.588904	1.867334	5.609420
8	0.141614	35.83854	33.65459	16.76865	4.438598	0.513686	3.463983	5.321955
9	0.158829	28.53411	27.34715	14.16038	11.72525	0.629502	3.356481	14.24712
10	0.177186	23.69972	25.48726	18.13698	10.64787	0.586684	5.569924	15.87156

Source: Authors' findings

Given that the forecasting error (S.E.) of each year is calculated based on the error of the previous year, during the period, the forecasting error (S.E.) consistently increases. According to the results, in the first period (short-term), 100% of the variance explanations of the error in the economic growth of the provinces are explained by itself. However, as the period increases, the impact of

independent variables increases in explaining the 'variance of error in the economic growth of the provinces.

In the second period (short-term), 2.1% of the explanations of this error are attributed to the growth of fiscal policy uncertainty, 0.81% to the growth of capital investment, 0.49% to inflation in the provinces, 0.43% to employment (unemployment rate) in the provinces, 0.17% to the growth of fiscal level shock, and 0.09% to the economic participation rate of the active labor force in the provinces. Therefore, in the short-term period, it appears that, after the lag of the dependent variable itself, the growth of fiscal policy uncertainty and capital investment in the provinces has had the most significant impact on the economic growth of the provinces.

In the fifth period (medium-term), 7.6% of the explanations of the error are attributed to the growth of fiscal policy uncertainty, 6.3% to inflation in the provinces, 5.8% to the growth of fiscal level shock, and 3.6% to the growth of capital investment. In the sixth period, 9% of the explanations are attributed to inflation, 8% to the growth of fiscal level shock, 7.3% to the growth of fiscal policy uncertainty, 5% to the growth of capital investment, and 2.3% to the economic participation rate of the active labor force in the provinces. Therefore, in the medium-term period, it appears that, after the lag of the dependent variable itself, the growth of fiscal policy uncertainty and inflation in the provinces has had the most significant impact on the economic growth in the provinces.

Moreover, the effect of the economic participation rate of the active labor force in the provinces on the economic growth of the provinces clearly becomes evident from the medium-term period (period 6) onward and reaches a substantial share of 5.6% by the end of the period (period 10).

In the tenth period (long-term), the explanations for the economic growth of the provinces are as follows: 25.5% of the explanations are attributed to the growth of fiscal policy uncertainty, 23.7% to the lag of the dependent variable itself, 18% to the growth of fiscal level shock, 15% to inflation in the provinces, 10% to the growth of capital investment in the provinces, and 5.6% to the economic participation rate of the active labor force in the provinces. Therefore, the share of the growth of fiscal policy uncertainty and the growth of fiscal level shock increase over time, from the medium-term periods to the end of the long-term period.

6. Conclusion

The response of both the GDP growth and the economic participation rate of the active labor force to the fiscal level shock is positive. Additionally, both variables responded negatively to the fiscal policy uncertainty shock with a one-period lag. The negative effect of the uncertainty shock is evident from the medium-term to the long-term periods. The response of investment to the fiscal level shock is

positive in the short term and then decreases. However, its response to the uncertainty shock is negative over the medium term, indicating that investment reacts quickly to these shocks. The response of the unemployment rate to the fiscal level shock was negative at the beginning of the period, leading to a reduction in unemployment. However, its response to the uncertainty shock was positive in the short term, leading to an increase in the unemployment rate. The response of inflation to the fiscal level shock is both decreasing and increasing. Its response to the uncertainty shock is inflationary in the short term, as the inflationary effect of the uncertainty shock outweighs the deflationary effect of the fiscal level shock. The combined impact suggests an increase in inflation in the short term to medium term. In the long run, however, the inflationary effect of the growth of fiscal level shock predominates. Based on the variance decomposition of the economic growth of the provinces, the share of the uncertainty shock and the fiscal level shock increases over time, from the medium-term to the long term. This highlights the priority of reducing fiscal policy uncertainty to increase the production of the provinces. From the medium term onward, the share of inflation and capital investment in the provinces will be more evident. The contribution of the economic participation rate of the active labor force in the provinces becomes critical in the medium term. This indicates the importance of increasing the participation of the active labor force in the provinces to affect the economic output in the provinces. Finally, the effects of economic sanctions need to be taken seriously, which have led to the increased fiscal policy uncertainty.

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نااطمینانی سیاست مالی و فعالیت‌های اقتصادی در استان‌های ایران

چکیده:
اثرات مثبت سیاست مالی را نااطمینانی همراه آن، می‌تواند از بین ببرد. در پژوهش حاضر، اثر نااطمینانی سیاست مالی بر فعالیت‌های اقتصادی در استان‌های ایران بررسی شده است. فعالیت‌های اقتصادی شامل تولید، سرمایه‌گذاری، بیکاری و مشارکت اقتصادی نیروی کار فعال در استان‌ها، با توجه به شرایط تحریمی اقتصاد ایران، است. از دو نوع شوک، شوک سطح مالی (به عنوان سیاست مالی) و شوک نوسان و بی‌ثباتی آن (به عنوان نااطمینانی سیاست مالی)، برگرفته از تابع واکنش مالی تصریح‌شده، استفاده می‌شود. یک مدل پانل ور با استفاده از داده‌های استانی از سال ۱۳۸۲ تا ۱۳۹۹ تخمین زده می‌شود.
طبق نتایج تابع واکنش آنی، در اثر تکانه بر نااطمینانی سیاست مالی، واکنش نشان‌دهنده افزایش نرخ بیکاری استان‌ها در دوره کوتاه‌مدت، واکنش کاهشی سرمایه‌گذاری عمرانی و واکنش افزایشی تورم استان‌ها، در دوره کوتاه مدت و میان‌مدت، واکنش کاهشی رشد تولید ناخالص داخلی و واکنش کاهشی نرخ مشارکت اقتصادی نیروی فعال در استان های ایران، در دوره میان مدت و بلندمدت، اتفاق می‌افتد.
کلمات کلیدی: سیاست مالی، عدم قطعیت، استان‌ها، اقتصاد ایران.