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Original Research Article

Measuring Fiscal Policy Uncertainty in Iran

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In Iran, following the intensification of economic sanctions during the 2010s and the exacerbation of the government's budget deficit, investment declined starting in 2012, which led to a reduction in GDP. As uncertainty accompanied fiscal policy, its positive effect weakened. We aim to measure fiscal policy uncertainty in Iran using a specified fiscal reaction function tailored to the oil-dependent and sanctions-affected economy in Iran. This function includes two types of shocks: fiscal level shock, and fiscal instability shock, which serves as a proxy for fiscal policy uncertainty. Previous studies used GARCH estimators to measure fiscal policy uncertainty in Iran; however, it cannot separate the instability shock from the level shock. Therefore, we estimated the fiscal reaction function using particle filters for Iran. The results suggest that in 2012, the intensification of sanctions led to an increase in fiscal policy uncertainty in Iran. From 2013 to 2016, the trend of the fiscal policy uncertainty has decreased mildly (by a maximum of 0.04). However, from 2017, the fiscal policy uncertainty index in Iran has rapidly increased, reaching its peak in 2020, whereas Iran's economy had not faced such high fiscal policy uncertainty (a maximum of +0.19) since 1979. In the 2000s, positive growth in fiscal level shocks generally compensated the adverse effects of fiscal policy uncertainty. However, in the 2010s, from 2012 onwards, with the intensification of economic sanctions, fiscal policy uncertainty has dominated over fiscal level shocks. Furthermore, the trend of overall budget balance or deficit closely aligns with the trend of the structural budget balance or deficit in Iran, indicating that the nature of the government's budget is structural and the government's budgetary discretionary decisions has increased during the period of intensified sanctions.

Keywords: Fiscal Policy Uncertainty, Fiscal Shocks, Cyclically Adjusted Budget Balance, Structural Budget
JEL Classification*:* E30, E62, H60

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1 Introduction

In Iran, especially following the economic sanctions of the 2010s, starting in 2012, oil revenues and foreign currency earnings faced significant instability and uncertainty. This led to an exacerbation of the government's budget deficit and instability, resulting in a decline in investment during the 2010s, followed by a reduction in production and an economic recession. During this period, the government played its economic role through fiscal policy. However, when fiscal policy implementation is accompanied by high uncertainty, it can significantly diminish the positive effects of the policy and even leave a negative impact on the economy, leading to ineffective fiscal policies. Therefore, the first issue is the neglect of the uncertainty accompanying Iran's fiscal policy.

As Anzuini et al. (2020) indicated, overlooking fiscal policy uncertainty can explain the varying coefficients and even different signs of fiscal policy effects in the empirical studies. Fiscal policy uncertainty negatively affects both macroeconomic and microeconomic activities (e.g., reduced hiring, lower employment, investment, and production). In Bloom theoretical model (2014), it is shown that in the short run, when there is an uncertainty shock, the effects of fiscal policy on output are reduced by about three-quarters.

The inefficiency of fiscal policy arises because firms delay their hiring plans and investment in the face of higher uncertainty. Additionally, negative effects of fiscal policy uncertainty may arise from higher financing costs due to risk premia and lower consumer expenditure as a result of prudential savings (Beckman and Czudaj, 2020).

The question that arises is: How significant is the fiscal policy uncertainty in Iran? Therefore, we need to measure fiscal policy uncertainty in Iran.

Thus, the aim of this research is to measure and introduce a new fiscal policy uncertainty index for Iran.

The literature on studies directly examining fiscal policy uncertainty based on survey data includes Beckman and Czudaj (2020) and Ricco et al. (2016). Their approach is based on the differences in forecasts by specialized forecasters regarding future budget balances, respectively for Germany and the United States.

Other studies rely on an indirect model, focusing more on estimating fiscal reaction functions to identify fiscal policy uncertainty (Popeil (2020), Fernandez et al. (2015), Anzuini et al. (2020)). Previous studies, such as Gali and Perotti (2003), Anzuini et al. (2020), and Anzuini and Rossi (2020),

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consider the budget balance as a primary determinant of the fiscal policy uncertainty index.

In another classification, previous studies on measuring fiscal policy uncertainty can be divided into three categories based on the core determinant of the fiscal policy uncertainty index as follows:

1) Tax policy uncertainty
2) Government spending uncertainty
3) Budget uncertainty

Among these three categories of determinants for the fiscal policy uncertainty index, the first and second categories each cover only one dimension of fiscal policy determinants. The third category, however, encompasses both the first and second categories by focusing on the budget balance as the core factor. Furthermore, recent empirical studies fall into the third category, often incorporating technical differences into the fiscal reaction function. Following this approach, we also use the budget balance as the basis for measuring the fiscal policy uncertainty index in Iran, with the distinction that we specify the fiscal reaction function according to the oil-dependent and sanctions-affected conditions of Iran's economy.

Another contribution of this paper is the introduction and practical application of a new fiscal policy uncertainty index for Iran. In this function, there are two types of shocks due to the fact that fiscal policy is fundamentally influenced by two types of shocks: first, the financial level shock (fiscal policy shock), and second, the instability shock, which serves as a proxy for fiscal policy uncertainty. Unlike previous studies that used GARCH estimators to measure fiscal policy uncertainty in Iran, we cannot separate the instability shock from the level shock using GARCH estimates. An important point, as discussed in detail by Fernandez and Ramirez (2013) and Fernandez et al. (2015), and also mentioned in subsequent studies such as Aunzini et al. (2020) and Popeil (2020), is that GARCH specifications only account for one shock that drives the dynamics of levels and volatility. Therefore, instead of using GARCH, we estimated this specified fiscal reaction function using practical application of particle filters with MATLAB coding for Iran.

Because we are utilizing the specified fiscal reaction function of the government, we need data on the cyclically adjusted primary budget balance relative to GDP as a dependent variable. Since this data is not available for Iran, it needs to be measured in this research. To obtain it, we first calculated the annual cyclical budget balance for Iran. The cyclical budget balance reflects the government's fiscal response (spending and taxes) to the

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economy's output gap. We then subtracted this cyclical budget balance from the total primary budget balance to obtain the cyclically-adjusted primary budget balance.

In the subsequent sections of the paper, Section 2 discusses the theoretical and empirical literature on the topic and highlights the contributions and distinctions of this paper. Section 3 addresses the factors affecting the government's budget balance or deficit in Iran. Section 4 provides the methodology of the research. Section 5 presents the data used in the research. Section 6 reports the results, including Section 6.1, which details the measurement of the cyclical budget balance and structural budget balance for Iran. In section 6.2. We conducted the required statistical tests before measuring fiscal policy uncertainty which includes a test for conditional variance or uncertainty. The Stationarity Test for the uncertainty measurement model variables and the Cointegration Test as well. Section 6.3 provides estimated results and detailed information on the trend of the fiscal policy uncertainty index in Iran and the measured fiscal level shock. Finally, Section 7 concludes by concluding remarks.

2 Literature Review

In economic theory, the argument is that uncertainty shocks explain economic fluctuations. Companies may react to uncertainty by adjusting hiring decisions and decreasing investment (Safari et al, 2024). Financial intermediaries may reduce lending, and households may increase savings (Bloom, 2014). Arroyo et al. (2023) explored fiscal policy fluctuations in a large sample of countries focusing on emerging market and developing economies and commodity exporters during 1990-2021. Their findings indicated that fiscal policy in developing and emerging market economies has been more unstable than in developed economies and in commodity exporters than non-commodity exporters. Their results indicated the adverse macroeconomic consequences of these additional fluctuations on economic growth. The existence of these fiscal policy fluctuations over a 30-year period explains 8% of the income gap between developing and emerging markets economies with developed economies.

As Anzuini et al. (2020) argue, a reason for this difference can be due to the uncertainty that lies in the implementation of fiscal policy.

Due to the volatility and instability of the growth rate in Iran, the growth had no significant impact in Iran (Mirjalili et al., 2017). Economic growth in Iran has been unstable, and firms in the provinces have not been able to

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maintain the economic growth (Mirjalili and Safari, 2019, p.55; Mirjalili et al., 2017).

The macroeconomic effects of fiscal policy are an economic issue that New Keynesian economists agree on. Therefore, the effects of fiscal policy are based on the presumptions of the New Keynesians about the efficacy of fiscal policy level shock and that fiscal policy stimulus can lead to macroeconomic outcomes (Mirjalili, 2015, p.448).

In the meantime, researchers have focused on uncertainty measurement and its transmission channels (Baker et al., 2016).

Baker et al. (2016) suggested an economic policy uncertainty index, which includes uncertainty, policy, and economy, and measures fiscal and monetary policy uncertainty.

In this paper, we focused on an uncertainty index for fiscal policy which can be a source of uncertainty for economic activists (Anzuini and Rossi, 2020). Previous studies, such as Beckmann and Czudaj (2020), Anzuini et al. (2020) employ the budget balance as a determinant for fiscal policy uncertainty.

In the fiscal response function, technical differences are taken into account. Ricco et al. (2016) and Beckmann and Czudaj (2020) employed fiscal policy uncertainty based on survey data.

Their method was based on the difference in expert forecasts of the future budget balance for the United States and Germany, respectively. Other studies employed the indirect model based on proxies or reaction functions to measure fiscal policy uncertainty (Fernandez et al. (2015), Anzuini et al. (2020), Popiel (2020)). In studies that employed proxies, a function is approximated through the volatility of shocks, which is, for example, based on average tax rates. These specifications take into account the total position of fiscal policy.

Anzuini et al. (2020) explored the issue for the Italian government budget, which is subject to significant fluctuations and high uncertainty (Anzuini et al., 2020).

The empirical studies on fiscal policy uncertainty mostly rely on the estimation of policy response functions to measure fiscal policy uncertainty (Anzuini et al. (2020), Popiel (2020)).

The methods of measuring fiscal policy uncertainty based on the determinant of the fiscal policy uncertainty index can be mentioned in 3 categories. Tax uncertainty, government expenditure uncertainty, and budget uncertainty.

The first category considers tax uncertainty as the determinant of the fiscal policy uncertainty index. Khalili et al. (2010) utilized the fluctuations of

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tax income during 1962-2007 to measure the uncertainty of tax policy in Iran. They employed the GARCH method to estimate tax uncertainty.

Brown et al. (2013) employed two methods to measure tax uncertainty. The first method measures tax uncertainty through the potential of a party in policy-making, given the percentage of their seats in the Senate and the House of Representatives. In the second method, they measure tax uncertainty as a part of the general measure of economic policy uncertainty employed by Baker et al. (2016).

Sameti et al. (2020) utilize the fluctuations of tax revenues (fluctuations of income tax, tax on legal entities, wealth tax, import tax, and tax on consumption of goods and services) to determine the fiscal policy uncertainty index in Iran. They employed the GARCH method to estimate tax uncertainty in Iran over the period 1979-2017.

The second category explores the uncertainty of government spending as a determinant of the fiscal policy uncertainty index.

Suri et al. (2011) utilized the fluctuations (unstable component) of government consumption expenditures to GDP ratio as a determinant of the fiscal policy uncertainty index over the period 1968-2000 in Iran. They employed the GARCH method, which divides the ratio into a stable component and an unstable component, which is the fiscal policy uncertainty index.

Emami and Ahmadi (2011) utilized the fluctuations of the government's current and capital expenditures in Iran to determine the fiscal policy uncertainty index over the period 1959-2006. They employed the EGARCH method.

Bagherzadeh et al. (2020) utilized government expenditure fluctuations to determine the fiscal policy uncertainty index over the period 1978-2018 in Iran. They employed the generalized autoregressive score model (GAS).

Haji MollaMirzaee et al. (2023) employed the fluctuations of the government's current and capital spending to estimate the uncertainty of the government's spending during 1986-2020 using the ARCH method.

The third category considers the budget balance as the core and budget uncertainty as the determinant of the fiscal policy uncertainty index.

Budget uncertainty is calculated either directly from the difference of experts' forecasts from the budget balance or indirectly from the GARCH method or the fiscal policy response function.

Hadian and Tahvili (2014) utilized tax fluctuations and budget deficit fluctuations to determine the uncertainty index of fiscal policy during 1973-2009 in Iran using the GARCH method.

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Fernandez et al. (2015) estimated the fiscal reaction function with both components of the budget variables over the period 1970-2014 to determine the uncertainty index of US fiscal policy. In fact, they employed the quarterly data for government expenditures and also US taxes as dependent variables in two regressions. The employed accumulation of government debt and US production as explanatory variables. As the fiscal policy of the US government was affected by two types of shocks, fiscal level shock and fiscal volatility shock (fiscal policy uncertainty index), they separated the effect of these two shocks. Therefore, due to the possibility of separating these two types of shock effects (the volatility of shocks also varies over time), they employed the particle-filter method for the estimation by encoding in MATLAB software.

Anzuini and Rossi (2020) employed the budget balance as the core and the standard deviation of experts' forecasts (through survey data) from the total US budget balance or deficit to determine the uncertainty index of fiscal policy over the period of 1993-2018.

Beckmann and Czudaj (2020) employed the budget balance as a core concept and utilized the deviation of expert forecasts on the future budget balance from the total government budget balance for Germany to determine the fiscal policy uncertainty index, using survey data over the period 1995-2018.

Anzuini et al. (2020) estimated a fiscal reaction function with the structurally adjusted budget balance, which allows the stability of shocks to vary over time to determine the fiscal policy uncertainty index, during 1981-2014. The volatility is a proxy for fiscal policy uncertainty. As the fiscal policy of the Italian government is affected by two types of shocks, fiscal level shock and fiscal policy volatility shock (fiscal policy uncertainty index), these two effects are separated. Thus, they estimated fiscal policy uncertainty using the particle-filter method and coding in MATLAB.

Aye (2021) utilized both components of the budget variables- fluctuations in government expenditures and taxes in South Africa - to determine the fiscal policy uncertainty index. Therefore, they employed the partial least squares structural equation model (PLS-SEM) using seasonal data of South Africa during 1990-2019.

Kasal and Tosunoglu (2022) employ the fiscal reaction function to identify the fiscal behavior of the Turkish government and to determine the uncertainty index of fiscal policy in Turkey. They employed cyclically adjusted primary balance (CAPB) as a dependent variable, and they employed its lag, debt accumulation, and output gap as explanatory variables.

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However, contrary to what Fernandez and Ramirez (2013), Fernandez et al. (2015), and Anzuini et al. (2020) suggest, they did not make a distinction between the fiscal level shock and the fiscal volatility shock (this shock is a proxy for the uncertainty of fiscal policy in other studies) and estimated the function and model using the ARCH method, which includes both shocks under one shock called the FPU index for Turkey using seasonal data during 1998-2020.

As mentioned, there are different methods for measuring the uncertainty of fiscal policy. The previous studies employed the GARCH method to estimate the uncertainty of fiscal policy. However, there is only one shock in the GARCH specification that triggers level dynamics and technology fluctuations: E_t. This means that when we have big changes, we will have a lot of volatility in the next period.

Therefore, we cannot separate a volatility shock from a level shock: higher instabilities are caused only by large level changes. The restriction is important in the structural models (Fernandez and Ramirez, 2013).

Therefore, considering that fiscal policy can be affected by two types of shocks: fiscal level shocks(u_t) and fiscal policy uncertainty shocks(ε_t), to estimate uncertainty, we employ particle-filter estimation, instead of GARCH, by encoding in MATLAB software.

2.1 Contributions and Distinction

On the determinants of fiscal policy uncertainty index, the first and second categories each cover only one determinant of fiscal policy uncertainty. In fact, the third category covers both. The recent empirical studies are in this category and include technical differences in the fiscal reaction function.

We also employed the budget balance as the basis. However, we utilized the uncertainty index of the fiscal policy for Iran in a specified fiscal reaction function according to the circumstances of Iran's economy.

As fiscal policy is affected by two types of shocks, fiscal level shocks and fiscal volatility shocks, using the GARCH estimation, we cannot separate the destabilizing shock from the level shock. Therefore, Popiel (2020) goes for stochastic volatility models instead of the GARCH method to separate fiscal level shock from fiscal policy uncertainty shock (fiscal volatility shock).

3 Government's Budget Balance or Deficit in Iran

We employed the budget balance as a dependent variable in a fiscal response function. Therefore, the determinants of budget balance or deficit in Iran were modeled to specify the fiscal reaction function according to the circumstances

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of Iran's economy. The government's budget balance in Iran is affected by the following:

A) Accumulation of debt: Accumulation of government is an element in the budget balance or deficit in Iran. According to Memariyan et al. (2022), during 1974-2019, there was no response from the Iranian government's budget balance to the accumulation of government debts. According to Fatahi et al. (2014), during 1978-2011, the reaction of the government budget balance towards the accumulation of debt was weak. They employed the fiscal reaction function for Iran.

B) Output gap: output gap affects the budget balance or deficit in Iran. According to Khavari and Mirjalili (2012), Chehrazi and Nejati (2017) and Saedi and Dargahi (2021), increasing output gap is associated with budget deficit in Iran. In fact, the positive output gap in Iran has been accompanied by the boom in oil revenue. Oil revenue has led to a further increase in government expenditure budget deficit, which is a sign of the pro-cyclical behavior of the government. The period of negative output gap (economic recession), which is associated with the decrease in oil revenues, reduced investment expenditures, and the stickiness of current expenditures, increased the government's budget deficit.

Zarieh et al. (2021) indicated that during 1976-2018, the monetary authorities in Iran did not react to the output gap, but the fiscal authorities responded by implementing expansionary policy, which is a sign of the discretionary behavior of the government.

C) The share of oil revenue: The ratio of oil revenue to GDP in Iran has been the most effective element on the budget balance or deficit in Iran. According to Farah Bakhsh and Mehrabian (2003), Niki Oskoi et al. (2009), Mowlaei and Abdian (2018), oil revenue is the primary source of budget balance or deficit in Iran, and the positive shock in the oil revenue has led to a decrease in the government's budget deficit. However, Dindar Rostami et al. (2019), based on the quarterly data of 1990-2017, concluded that the positive shock of the oil price has led to an increase in the total and structural budget deficits in Iran.

Saedi and Dargahi (2021) indicated that the oil boom, during 1965-2019 resulted in an increase in government spending and a budget deficit. The period of economic recession has also been accompanied by a decrease in oil revenues, which has led to an increase in the budget deficit because of the stickiness of government expenditures, especially current expenditures.

D) The share of government expenditures: The ratio of government expenditures to GDP affected on the budget balance or deficit in Iran. This

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fact is the result of Komijani and Varhrami (2012), Mowlaei and Abdian (2018), Saedi and Dargahi (2021). They indicated that increasing the share of government expenditures in GDP has led to an increase in the budget deficit in Iran.

E) Financial sanctions: Sanction has been an important factor affecting the budget balance or deficit in Iran. It has appeared in the model as a dummy variable. The objective of economic sanctions against Iran, as mentioned in the Art of Sanctions by Nephew, was to damage the ability of the economy to obtain and use economic resources, including foreign exchange resources, which led to a government budget deficit (Mirjalili, 2021, p.87). According to Saedi and Dargahi (2021), sanctions have led to an increase in the government's budget deficit in Iran.

Since 2012, Iran's economy has been adversely affected by the intensification of sanctions, especially in trade, banking and oil industry. Therefore, economic sanctions adversely affected the government revenues, which are dependent on oil proceeds, and thus the economy faced more uncertainty in realizing the objectives of development plans (Mirjalili, 2022).

Mirjalili and Karimzadeh (2021) explored the negative oil revenue shock for depositing in the sovereign fund of Iran as a fiscal policy using a DSGE model. The impact of sanction as a negative oil revenue shock leads to the reduction of government revenues and investment (Heydarian et al, 2022 and 2023). Also, counter-cyclical fiscal policy is practically impossible without the foreign exchange resources of the Fund to absorb the negative shock of sanctions (Mirjalili and Karimzadeh, 2021, pp. 671-673).

F) The real exchange rate: It has been affecting the budget balance or deficit in Iran. According to Asgharpoor and Bradran (2018), an increase in the exchange rate has led to an increase in government expenditures, which has been more than government revenues and resulted in a budget deficit. Heydarian et al. (2021) explored the impact of financial sanctions on growth. They indicated that sanctions targeted oil revenues, the main source of government budget. As a result, especially since 2012, oil revenues have fallen significantly, which was a reason for the government budget deficit (Heydarian et al., 2021).

G) Inflation: The increase in the consumer price index, or inflation, has been affecting the budget balance or deficit in Iran. According to Farzinvash et al. (2003), Farah Bakhsh and Mehrabian (2003), Mowlaei and Abdian (2018), inflation has led to the increase in government budget deficit. Farzinvash et al. (2003) examined two opposing perspectives in Iran’s economy using the quarterly data of 1981-2000. Initially, inflation can lead to

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declining real tax revenues (the Tanzi effect) and then increase the budget deficit. On the contrary, inflation can lead to a decrease in real government expenditures (Patinkin effect), and then the budget deficit will be adjusted.

However, using quarterly data of 1990-2017, Dindar Rostami et al. (2019) indicated that inflation, in accordance with Patinkin's hypothesis, led to the reduction of the total budget deficit and the structural budget deficit in Iran. Also, Asgharpoor and Bradaran (2018) also find the identical results of reducing the government budget deficit resulting from inflation, using quarterly data of 1991-2015.

H) Last year's budget balance: It has been affecting the current budget balance or deficit in Iran. Using a fiscal reaction function, Fatahi et al. (2014) indicated that the budget balance or deficit of the last year had a positive effect on the current budget balance or deficit in Iran.

4 Methodology

To measure the uncertainty of fiscal policy in Iran, we follow Born and Pfeifer (2014), Fernandez et al. (2015), Anzuini et al. (2020), and employ the fiscal reaction function.

However, we specified the function according to the sanctions and oil circumstances of Iran's economy. To estimate fiscal uncertainty, we employed a particle filter, rather than GARCH, by encoding in MATLAB software, according to Anzuini et al. (2020).

We employed the government's specified fiscal reaction function. Therefore, we need to calculate the cyclically adjusted primary balance of the budget to GDP ratio.

As the data is not available for Iran, in this paper, we will measure the ratio. We initially calculate the annual cyclical budget balance for Iran. In fact, the cyclical budget balance is the government's fiscal reaction (expenditures and taxes) to the country's output gap. Then, by employing it, we derive the cyclically adjusted primary budget balance for Iran.

Next, we will address the structure of the measurement model for the fiscal policy uncertainty that is specified for Iran.

The contribution of this paper is the method of measuring the government's fiscal reaction function. To calculate fiscal policy uncertainty index for Iran,

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we employed the uncertainty of the government budget deficit or structural budget balance for Iran.[1]

The literature review of the fiscal policy uncertainty index indicates that the majority of previous studies consider the budget balance as the core of the fiscal policy uncertainty index and employ the indirect model based on proxies or fiscal reaction functions to identify fiscal policy uncertainty (Fernandez et al., 2015; Anzuini et al., 2020; Popiel, 2020). Therefore, we follow Fernandez et al. (2015), Popiel (2020), and especially Anzuini et al. (2020) to measure fiscal policy uncertainty in Iran.

We initially estimate a fiscal reaction function. The key difference with prior empirical studies is that the fiscal rule incorporates not only a new change in the level but also the volatility of the fiscal position (technically, adopting a stochastic volatility model).

As a fiscal rule, important parameters are considered in the fiscal reaction function, which determines the fiscal and budgetary behavior of the government in response to the public finances and the cyclical conditions. In equation (1), we included the reaction of the real budget balance to the public finance (measured by the gap between the adjusted initial balance and the debt gap), because the reaction of the country's real budget balance to cyclical conditions (measured by the level of output gap) we subtracted from it, which is mentioned under the title of cyclically adjusted budget balance and as a dependent variable in equation (1). We estimate a state space model of the following two equations.

$$def_t = \beta_1 def_{t-1} + \beta_2 debt_{t-1} + e^{h_t} u_t \quad \text{where } u_t \sim N(0,1) \tag{1}$$

$$h_t = \alpha_0 + \rho h_{t-1} + \gamma \varepsilon_t \quad \text{where } u_t \sim N(0,1) \tag{2}$$

In equation (1), def_t denotes the cyclically adjusted ratio of the initial borrowing requirement of the government and GDP at time t, or the ratio of the initial balance of the cyclically adjusted primary budget balance to GDP, def_{t-1} .The cyclically adjusted ratio of the primary borrowing requirement of the government budget and GDP at time t-1 or the previous year, $debt_{t-1}$ which denotes the government debt ratio in the previous year, h_t which denotes the logarithm of the volatility of the error term. ρ denotes the

[1] Structural budget balance or deficit, or cyclical adjusted budget balance, is a component of the total budget deficit or balance that is not affected by cyclical fluctuations (Fedelino et al., 2009). In other words, the deficit or the balance of the total government budget from which the cyclical effects, temporary effects, and lack of long-term effects - the temporary character of those measures and the lack of a long-term effect- have been deducted (Hlivnjak and Laco, 2018).

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persistence component of the log-volatility and γ denotes the volatility of the shocks to the log- volatility.

Equation (1) is the standard fiscal reaction function (see, for example, Gali and Perotti, 2003, or the survey by Golinelli and Momigliano, 2009).

Uncertainty is obtained from the error term of Equation 1, which is the difference between the observed value of the past trend and the explanatory data, representing any actions by the government that are unpredictable.

Equation (2), on the contrary, provides the law and the possibility of movement for deficit fluctuations and instability, which in the model is not necessarily deterministic (like the GARCH model), but includes a random component (advantages of a stochastic instability model -SV with respect to GARCH in Fernandez and Ramirez (2013) are highlighted). Equation (2) includes the main idea: fiscal policy can be affected by two new shocks: fiscal level shocks u_t and fiscal policy uncertainty shocks (ε_t). In fact, the instability of shocks varies over time. The time series of these instability shocks is a proxy for fiscal policy uncertainty.

In this paper, like Anzuini et al. (2020), but different from Born and Pfeifer (2014) and Fernandez et al. (2015), we measure the total budget balance or deficit (total primary deficit - cyclically adjusted). Because this inclusive variable is the most widely used indicator of governments' fiscal stance (Anzuini et al., 2020).[1]

In the development plans in Iran, on the one hand, there were some fiscal rules; however, in practice, certain fiscal rules have not been observed, so that in the 2000s, the oil revenues increased budget revenues, and hence, expansionary policy was pursued by the government and the budget deficit was aggravated.[2]

[1] The concept of "fiscal stance" is used to measure the government's discretionary budgetary decisions with respect to the stabilization of the economy (Zoppe and Gotti, 2021).

[2] Fiscal rules are proposed to reduce the instability of fiscal policy and stabilize it. By controlling discretionary budgetary and extra-budgetary policy decisions. Also, by limiting the possibility of political interventions in different stages of budget approval and implementation and by controlling and limiting the entry of resources from oil revenues into the budget.The fiscal rules can be applied: 1. Quantitative and numerical criteria, such as setting the budget deficit ceiling at 3% of GDP and the debt ceiling at 60% of the GDP of the economic and monetary union (EMU). 2. The criteria for procedural reform or procedural rules for budgeting and regulating responsible fiscal behavior. It is like linking the government's budget balance or deficit to the output gap, to the debt accumulation, to the state of employment, etc. Based on these fiscal rules, deposits and withdrawals are made from the soverign wealth fund (SWF) in oil-exporting countries such as Norway and Nigeria.

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In the 2010s, the intensification of sanctions against Iran and the reduction of oil revenue, withdrawals were made from the National Development Fund and the foreign exchange reserve account outside of the annual budget bill, and the implementation of discretionary fiscal policy increased in practice. The compliance of the government budget deficit with the structural budget deficit indicates this point (Figure 5).

According to the theoretical background and empirical studies mentioned in the previous section under the title of factors affecting the balance or deficit of the government's budget, we specify equation (1). In addition, as the oil revenue has also been affected by the intensification of Iran's economic sanctions in the 2010s, the dummy variable for sanctions is included in the specified equation (1) (specified fiscal reaction function). Among the other important factors affecting the government's budget balance or deficit, according to theoretical and empirical bases, are: share of government expenditure, exchange rate, and inflation, along with the share of oil revenues. Therefore, the specified equation is as follows:

$$def_t = \beta_1 def_{t-1} + \beta_2 debt_{t-1} + \beta_3 \frac{oil\ income}{gdp} + \beta_4 \frac{government\ expenditure}{gdp} + \beta_5 sanction + \beta_6 \log exchange + \beta_7 \log CPI + e^{h_t} u_t \quad \text{The Specified Equation (1)}$$

$$h_t = \alpha_0 + \rho h_{t-1} + \gamma \varepsilon_t \quad (2)$$

In equation (1), we added the share of government expenditure to GDP, the logarithm of the market exchange rate, and the logarithm of the consumer price index.

Using the equations (1) and (2), we derive fiscal level shocks (u_t) and fiscal policy uncertainty shocks (ε_t) which are considered indicators of fiscal policy uncertainty. We employed MATLAB software to encode them.

Including a stochastic volatility factor is important from an economic perspective to include the nature of fiscal policy; however, it comes with some

The most important fiscal rules mentioned in Iran's development plans are as follows: 1. Establishing a foreign currency reserve account during the third and fourth development plans (2000-2010); 2. Establishing the National Development Fund and foreign currency reserve account based on articles 84 and 85 of the law for the fifth development plan; 3. Determining the ceiling of the deficit in the fourth development plan. 4. During the fifth development plan, ending the dependence of the government's current expenses on oil revenues (in paragraph (c) of Article (234) of the law for the fifth development plan) (Ghasemi and Mohajeri, 2014). 5. According to the law of the 6th development plan, the government should deposit 30% of oil revenues to the national development fund (Research Center of the Parliament, 2016).

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computational costs that cannot be ignored. In fact, as the model is nonlinear, it prevents employing the Kalman filter, which required the model to be linear and Gaussian. Therefore, to estimate the specified equations (1) and (2), we estimate the particle filter by encoding in MATLAB software.

The h_t process is unobservable and needs to be estimated along with other specification parameters: γ،α_0،β_1، β_2، β_3،ρ.

The integrals involved in the calculations are approximated employing discrete random samples that are derived by approximation (the algorithm for the particle filter was developed by Gordon et al.). Other important parts developed by Doucet et al. are included.

Following Anzuini et al. (2020), we employ the Liu and West (2001) version for the particle filter, which allows the connected estimation of state and parameter vectors, and provide the following re-parameterization of the model:

$$\alpha_0 \equiv (1-\rho)\omega$$
$$\rho \equiv \frac{\exp(\overline{\rho})}{\exp(\overline{\rho})+1}$$
$$\gamma \equiv (1-\rho^2)^{\frac{1}{2}} e^{\overline{\gamma}}$$

We estimate ω, $\overline{\rho}$ and $\overline{\gamma}$ instead of α_0, ρ and γ. In addition, re-parameterization provides the possibility of relatively smooth interpretation of parameters requiring estimation. In fact, $E(h_t) = \omega$, so that ω is the instability of the logarithmic model, and $var\ (h_t) = e^{2\overline{\gamma}}$ and so that $sd(h_t) = e^{\overline{\gamma}}$.

Finally, to derive the final estimate, we employ the smoother of Godsill et al.'s (2004). In the above fiscal reaction function (specified equation 2), the ratio of the cyclically adjusted primary balance of the budget to GDP is employed as a dependent variable. As the data is not available for Iran, we measured it in this paper.

5 Data

The data sources for this paper are presented in Table 1 and Table 2.

[DOI: 10.61186/jme.18.4.457]

Table 1
Sources of data to calculate fiscal policy uncertainty

Data	**Source**
Cyclically adjusted primary budget balance	Authors'calculation
The price index	CPI calculated as a difference between nominal and actual consumption at the constant price of 2011 of the Iran Statistical Center. The GDP deflator is calculated as a difference between nominal and real GDP at the constant price of 2011 by the Iran statistical center.
The real market exchange rate	market exchange rate, derived from the central bank database, make it real using the CPI index and the deflated import index at a constant price of 2011.
Government Debt	Reliable and officially published statistical data for government debt data in Iran is not available in a time series; however, the time series were made by Mousavi Nik and Bagheri over the period 1979 to 2015. Data are not available for 2015 to 2020; hence, using the particle-filter method, we estimated them.
Interest Payment, Oil revenue, aggregate expenditures, and current expenditures of the government	time series data of the Central Bank of Iran

Source: Research Findings

[DOI: 10.61186/jme.18.4.457]

Table 2
Sources of data to calculate cyclically adjusted primary budget balance (CAPB)

Data	**Source**
actual indirect tax, personal income tax, corporate tax, Actual annual budget balance of the government	time series data of the Central Bank of Iran, actual annual budget balance of the government, based on Hagemann, 1999; Irwin, 2015; Saedi and Dargahi, 2021, we calculated by consolidation of the operating budget balance and the capital balance derived from the time series of the central bank of Iran.
The balance of the government's annual cyclical budget	Author's calculation based on the van den Noord method, OECD, 2000
Output gap	We estimated the output gap using the data from the Iran Statistical Center by the Hodrick-Prescott filter method.
Nominal and real GDP in Iran	Statistical Center of Iran, GDP in terms of marginal cost components at current and constant prices (billion rials), 2011 base year, Statistical Center of Iran
Social security contribution, unemployment benefits	time series of social security, income sources, and unemployment benefit fund
The elasticity of taxes, the elasticity of government expenditures	The author's calculation is based on the van den Noord method, OECD, 2000; the calculation formulas are given in Appendix (1).
Labor wages	According to the Labor Law, Social Security
Labour supply, unemployment, employment ratio, potential employment, private consumption	Potential employment was calculated using data from the yearbook of the Iran Statistical Center. Private marginal consumption expenditure, Department of the Statistical Center at a constant price in 2011.

Source: Research Findings

The variables of the model, along with their descriptive statistics are provided in Table 3.

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Table 3
Variables and descriptive statistic

variable	observation	Mean	Standard Deviation
Cyclically Adjusted Primary Budget Balance	47	-0.017553	0.051337
Government Expenditures to GDP ratio	47	0.180450	0.048388
Oil revenue to GDP ratio	47	0.079549	0.034324
Interest Payment to GDP ratio	47	0.001339	0.001570
Log of CPI	47	0.951918	1.077862
Log of the real market exchange rate	47	3.470628	1.194941
Government Debt to GDP ratio	47	0.428208	0.437144

Source: Research Findings

We initially observe the trend of the variables affecting the budget balance or deficit. Then we elaborate the structure of the model.

5.1 The Trend of Output Gap and Cyclical Budget

In response to the output gap, the reaction of the governments in developed countries is countercyclical policy. However, in most developing and oil-rich economies, the trend is pro-cyclical (Saedi and Dargahi, 2021).

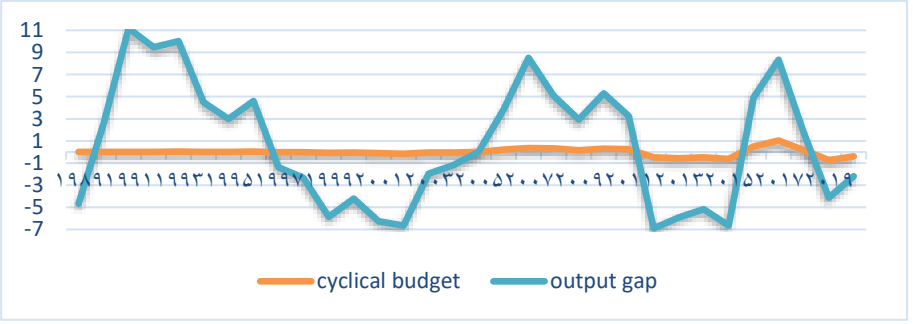

Figure 1. Output gap and cyclical budget in Iran (1989-2020)
Source: Authors' calculations; Data source: The Central Bank of Iran (CBI) and The Statistical Center of Iran (SCI)

The trend of the output gap and the government's cyclical budget is illustrated in figure 1. As illustrated in Figure (1), the percentage of Iran's cyclical budget, from the first development plan to the sixth development plan,

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is very low. In addition, the structural budget response has also been aligned with the country's output gap. The increasing aligned trend happened in 2006, 2007, and 2010.The decreasing aligned trend occurred in 2010s with the intensification of economic sanctions. Therefore, the government's structural budget was mostly pro-cyclical.

According to Ghasemi and Mohajeri (2014), during 1966-2013, the hypothesis of countercyclicality of fiscal policy in Iran could not be accepted. According to figure (1), since 1979 and in the 1980s, there has been an economic recession in Iran. In the 1990s the economic recovery happened. In the 2000s, oil prices and government revenues increased. Hence, there was a positive cyclical budget in 2006, 2007, 2010, which aligned with the positive output gap.

Since 2012, by the intensification of economic sanctions and the decrease of oil revenues, the cyclical budget turned negative, which was aligned with the negative output gap (economic recession), except for 2016-2017 of JCPOA implementation, which, as figure (2) illustrates the procyclical movement of incremental positive cyclical budget and positive gap (economic boom).

5.2 The share of oil revenues: a trend

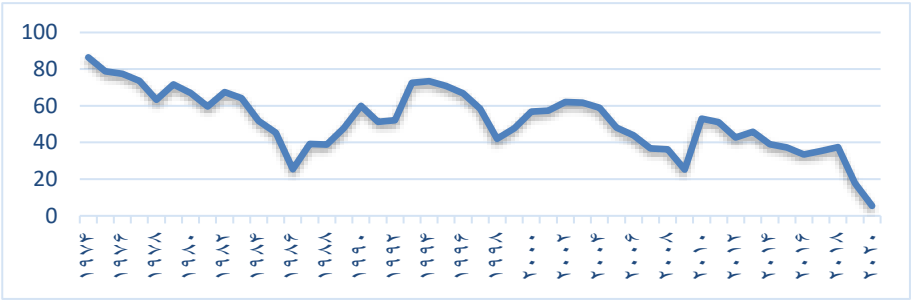

Figure 2. Oil revenue to government public revenue ratio (%)
Source: Authors' calculations; Data source: The Central Bank of Iran (CBI)

Figure (2) illustrates the share of oil revenues in the total government's budget revenues, which indicates the level of dependence of the government's budget on oil. The share was very high before the 2010s, so that in 2010 it was 53%.

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However, due to the tightening of the sanctions on oil revenues in the 2010s, there was a decrease in the share of oil revenues to total revenues of the government's budget.

Especially in 2020, the share reached 6%, the lowest ratio. Another reason for the decrease in the share of oil revenue in the total budget revenue in diagram (2) is the allocation of foreign exchange from exports at a concessional rate (Research Center of Parliament, 2022).

5.3 The share of government expenditure: a trend

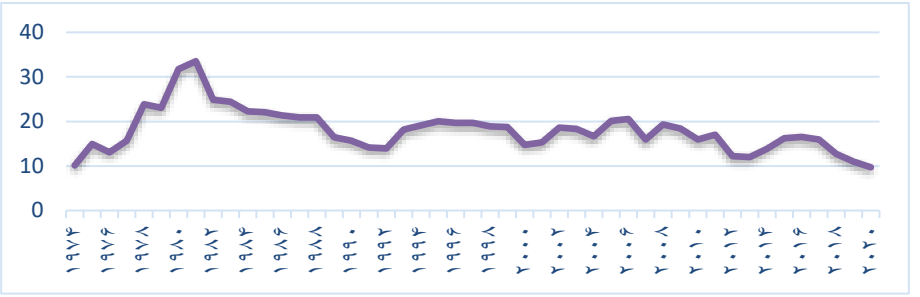

Figure 3. Share of Government Expenditure (% of GDP)
Source: Authors calculations; Data source: The Central Bank of Iran (CBI) and The Statistical Center of Iran (SCI)

Figure 3 illustrates the share of government expenditures in GDP. During the oil boom of 1974 to 1981, the ratio of government expenditures to GDP increased. During the 1980s, along with the economic recession, the government's expenditures have been in a downward trend. Since the implementation of the first development plan until the 2010s, it has fluctuated between 15% and 20% of GDP. However, in the 1990s, in the wake of tightening economic sanctions in 2012 and 2013, it dropped and fluctuated between 10% and 15% of GDP; then it began a downward trend in 2018, and in 2020 it reached its lowest level, less than 10% of GDP.

5.4 market exchange rate in Iran

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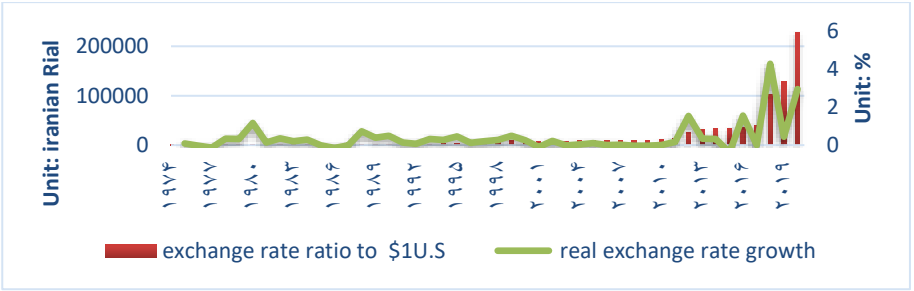

Figure 4. Iran's Exchange Rate
Source: Authors' calculations; data source: the Central Bank of Iran (CBI) and the Statistical Center of Iran (SCI).

Figure (4) illustrates the trend of the real exchange rate and its growth in Iran. The market exchange rate has grown since 1979. In the 1990s, with the intensification of sanctions and the reduction of foreign exchange earnings during the 2010s, there was volatility in the market exchange rate in Iran.

In 2018, the withdrawal of the United States from the JCPOA led to the re-intensification of US sanctions against Iran and consequently the exchange rate depreciated, which resulted in a growing gap between the official and market exchange rates.

The increase in the exchange rate gap has put the government's budget balance under pressure because the government has been allocating and providing foreign exchange for basic goods, etc., with concessional exchange rates. Therefore, the effect of increasing the market exchange rate and creating an exchange rate margin by allocating the government's concessional exchange rate manifests itself in the increase of the government budget deficit. Figure 5 indicates the soaring of the government budget deficit in the 2011s.

6 Results

6.1 Measuring Structural and Cyclical Balanced Budget

An important issue in the fiscal rule is the adjusted rule, which puts a ceiling on the budget deficit so that taxes, government expenditures, and allocated subsidies are adjusted accordingly to the output gap, and therefore, the output gap becomes zero (Kordbcheh, 2018; Saedi and Dargahi, 2021).

Cyclically-adjusted primary budget balance is actually the deficit or primary balance of the government budget or primary balanced budget from which the cyclical effect of the business cycle has been deducted (Hlivnjak

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and Laco, 2018). [1] In other words, it shows the structural primary budget balance for Iran. The annual budget balance consists of two components: cyclical and structural balance (Gali and Perotti, 2003).

Cyclical or non-discretionary balance indicates changes in the budget balance that are due to factors beyond the direct control of political powers, such as cyclical fluctuations that happen due to the reaction of government spending to the unemployment rate and the reaction of taxes to the output gap, and acts as an automatic stabilizer of the budget.

Structural balance, discretionary or cyclically adjusted balance (because the effect of cycles has been deducted from the budget balance), is under the control of policymakers. In other words, it is the reaction of the government's fiscal policy, which operates at the discretion of governments.

To derive the structural primary balance budget for Iran, or the dependent variable of the fiscal reaction function in equation 1 (cyclically adjusted primary budget balance), we first calculated the annual cyclical budget balance for Iran.

Then we subtract the total primary budget balance from the cyclical budget balance to obtain the cyclically-adjusted primary budget balance.

The cyclical budget balance is the government's fiscal reaction (expenses and taxes) to the output gap. To this end, we employ van den Noord's methodology, OECD, 2000. Equation (3) provides the formula for calculating the cyclical budget balance.

$$b^{**} = \frac{T_1}{Y}\left[1-\left(\frac{Y^*}{Y}\right)^{\alpha_1-1}\right]+\frac{T_2}{Y}\left[1-\left(\frac{Y^*}{Y}\right)^{\alpha_2-1}\right]+\frac{T_3}{Y}\left[1-\left(\frac{Y^*}{Y}\right)^{\alpha_3-1}\right]+\frac{T_4}{Y}\left[1-\left(\frac{Y^*}{Y}\right)^{\alpha_4-1}\right]-\frac{G}{Y}\left[1-\left(\frac{Y^*}{Y}\right)^{\beta-1}\right]+\frac{X}{Y}\left[1-\left(\frac{Y^*}{Y}\right)^{-1}\right] \quad (3)$$

In which b^{**} =cyclical budget balance, $T_1 =$ personal income tax, T_2= Corporate tax, $T_3 =$ Social security tax

$T_4 =$ Indirect tax , $Y^* =$ level of potential output , $Y =$ level of total output ,

α_i =elasticity of ith tax category with respect to output,

$G =$ total government expenditures, $X =$ non-tax revenues,

$\beta =$ elasticity of current government expenditures to output

[1] The difference between the balance of the total budget and the primary balance of the total budget is that in the total budget balance, interest payment for public debt is included and deducted. Therefore, we added the total budget balance to the interest repayment to derive the primary budget balance or deficit.

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The formula to derive the elasticities is provided in Appendix (1). The elasticity of personal income tax to output is equal to -0.068, the elasticity of corporate tax to output is equal to 1.78, the elasticity of insurance premiums paid to the government to output is equal to -0.04, the elasticity of indirect taxes to output is equal to 0.58, and the elasticity of government current expenditure to output is -0.21. The trend of the government's total, the structural, and the cyclical budget balance in Iran are illustrated in figure 5.

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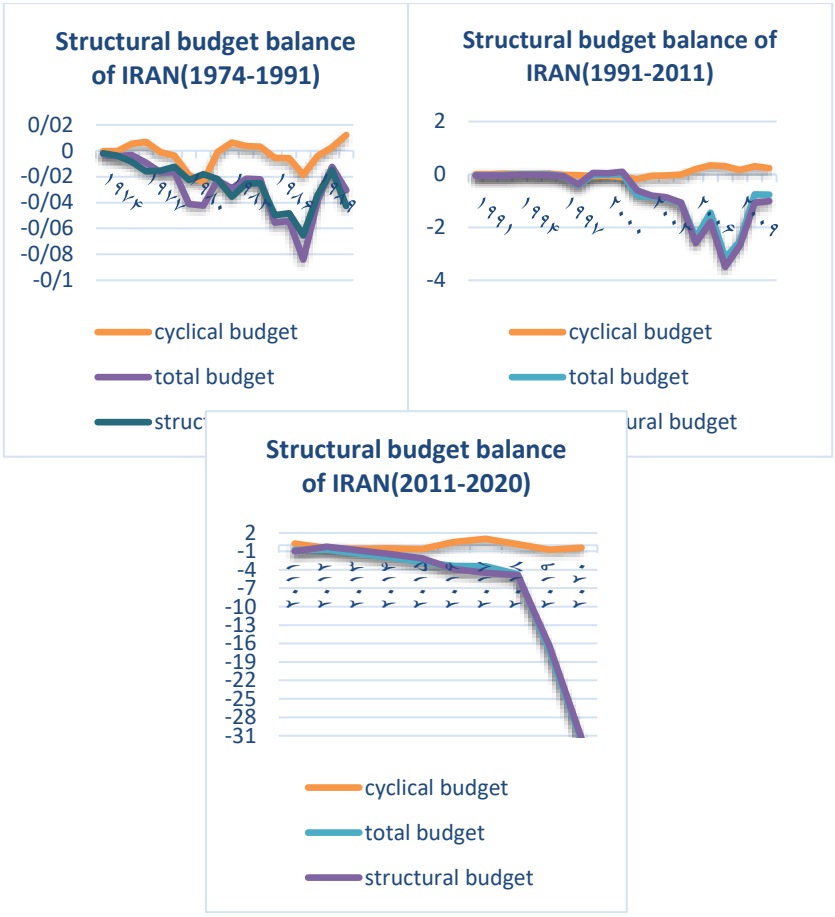

Figure 5. Total, Structural, and Cyclical Budget Balance in Iran
Source: Authors' calculations; structural budget balance, total budget balance, and cyclical budget balance as a percent of GDP.

Figure 5, illustrates that government's budget deficit has been aligned with the structural budget deficit, especially in the 2010s, which indicates that government's budget deficit is a structural budget deficit. Although the intensification of sanctions in the 2010s, the trend of total budget deficit and structural budget deficit has deteriorated; however, the alignment of these two deficits goes back to periods before the sanctions and seems to be affected by

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budget dependence on oil export revenues. The cyclical budget suggests the reaction of the government's fiscal policy in the form of discretionary decisions and policies, which are reflected in the structural budget.

6.2 Statistical Tests

6.2.1 Testing Conditional Variance or Uncertainty

Before measuring the uncertainty of fiscal policy, we need to ensure about the uncertainty or conditional variance (ARCH effects) in the specified equation 1. If the data for the variables in equation 1 were available on a monthly basis, the variance or standard deviation for each year could be calculated, and an indicator for the existence of uncertainty could be presented. However, since the data are usually available annually, models such as GARCH can be used, which directly estimate variance or standard deviation and provide a measure for the existence of uncertainty and conditional variance in equation 1.

In this model, for the dependent variable in equation 1, an autoregressive model is used along with the variables that play a role in its explanation. If, in such a model, the variance is constant, the dependent variable has no uncertainty, and the regression equation (equation 1), which is the conditional mean equation (equation 3), would suffice for forecasting. However, if the variance of the dependent variable in equation 1 is not constant, then it is subject to uncertainty (Suri et al, 2011). The results of the GARCH estimation for equation 3 and equation 4 are presented in the following.

$$\underset{}{\boldsymbol{def_t = 6.861 + 1.419\, def_{t-1} + 0.804\, debt_{t-1} - 5.983 \frac{oil\ income}{gdp} + 5.865 \frac{government\ expenditure}{gdp}}}$$
$$\underset{(0.0000)\quad (0.0000)\qquad (0.0021)\qquad (0.0000)\qquad (0.0087)}{}$$
$$\underset{}{\boldsymbol{+0.234\, sanction - 2.745 \log exchange + 3.029 \log CPI}}$$
$$\underset{(0.0761)\qquad (0.0000)\qquad (0.0000)}{} \quad (3)$$

$$\delta_t^2 = 0.08 + 1.668\varepsilon_{t-1}^2 + 0.143\delta_{t-1}^2 \quad `$$
$$\underset{(0.0332)\quad (0.0077)\qquad (0.0094)}{} \quad (4)$$

Note: The numbers in parentheses are the P-values of the respective variables.

Equation 4 is the conditional variance equation for the cyclically adjusted primary budget balance to GDP (def_t), which states that the variance for t is a function of the variance for t-1 and the squared error for t-1, i.e., ε_{t-1}^2 represents the estimated errors of the conditional mean equation, which is derived from equation 3. Equation 4 essentially represents the variance or uncertainty in def_t.

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As the results of equations 3 and 4 show, the variance of the dependent variable in equation 1 is not constant, and conditional variance (an indicator of uncertainty) exists in the residuals of equation 1.

6.2.2 The Stationarity Test

Before measuring the trend of fiscal policy uncertainty in Iran, we test the stationarity of the variables used in the estimation equation of Iran's fiscal reaction function (The Specified Equation (1)). The results are presented in Table 4.

We employed the Augmented Dickey-Fuller test to examine the stationarity process of the variables (unit root).

H_0= (Non-stationary). There is at least one common unit root.

H_1= (Stationary). There is no common unit root.

Table 4

The Results of Augmented Dickey-Fuller Unit Root Test

variable	Test Statistic	P-Value	I (0) Result	I (1) Result
Cyclically Adjusted Primary Budget Balance	1.084538 (-5.686024)	0.9968 (0.0000)	Do not reject H_0	Reject H_0
Government Expenditures to GDP ratio	-2.257754 (-6.833501)	0.1897 (0.0000)	Do not reject H_0	Reject H_0
Oil revenue to GDP ratio	-1.535790 (-6.552844)	0.5068 (0.0000)	Do not reject H_0	Reject H_0
Interest Payment to GDP ratio	-1.416319 (-6.701434)	0.5662 (0.0000)	Do not reject H_0	Reject H_0
Log of CPI	-0.243746 (-3.674608)	0.9250 (0.0079)	Do not reject H_0	Reject H_0
Log of the real market exchange rate	0.772446 (-3.998225)	0.9924 (0.0033)	Do not reject H_0	Reject H_0
Government Debt to GDP ratio	-1.781261 (-3.810327)	0.3848 (0.0054)	Do not reject H_0	Reject H_0

Source: Research Findings

The numbers in parentheses are the test statistic and P-value at the I (1) level. A P-value is significant at the 5% level.

The results in Table 4 indicate that the variables used in the specified equation 1 are not stationary at the level, but they become stationary after first differencing. Now, it is necessary to examine the cointegration test between the variables. If cointegration is not rejected, the variables can be included in the model at the level and avoid spurious regression. This is because differencing non-stationary time series eliminates the valuable information

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these series provide about the long-term relationship between the economic variables. The cointegration theory seeks to estimate this long-term relationship using non-stationary series rather than differencing them (Baltagi, 2012, p. 605).

6.2.3 Cointegration Test

We employed the Engle-Granger cointegration test to examine the cointegration between the variables:

H_0=No cointegration exists.

H_1=Cointegration exists.

We conducted a unit root test on the residuals of the regression equation (the residuals of Specified Equation1) based on the Engle-Granger cointegration test. If the residuals are stationary, there is a long-run relationship between the variables in the regression equation. Therefore, with the non-rejection of cointegration, the variables can enter the model at the level, avoiding spurious regression.

The results of the Engle-Granger cointegration test are indicated in Table 5:

Table 5

Cointegration Test Results

Model	Test Method	Test Statistic	P-Value	Result
Specified Model	ADF	-9.187072	0.0000	Reject H_0

Source: Research Findings

Based on the results illustrated in Table 5, cointegration, in the specified equation 1 is accepted at the 5% significance level. Therefore, despite the variables being stationary at I(1), since the regression residuals are cointegrated, the variables can enter the regression equation (specified equation1) at the level and free from spurious regression.

6.3 The Trend of The Fiscal Policy Uncertainty Index and Fiscal Level Shocks (Fiscal Policy) in Iran

To measure fiscal policy uncertainty in Iran, we employed a fiscal reaction function, as explained in the methodology and model structure section. This fiscal reaction function has been specified according to the oil-dependent and sanctions conditions of Iran's economy, in line with the significant factors affecting the fiscal reaction function (budget deficit or balance reaction function) in Iran, which is detailed in Section 3.

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The key point is that to estimate the equations of this specified fiscal reaction function for Iran, namely the specified equation 1 and equation 2, which are provided in the methodology section, we need to consider that fiscal policy is fundamentally affected by two types of shocks: fiscal level shocks and fiscal instability shocks (an approximation for fiscal policy uncertainty). Unlike previous studies that used GARCH estimators to measure fiscal policy uncertainty in Iran, we cannot separate instability shocks from level shocks using GARCH estimation. As explained in Fernandez and Ramrez (2013), Fernandez et al. (2015), Anzuini et al. (2020), and Popiel (2020), there is only one shock in GARCH that stimulates both level dynamics and volatility. Therefore, following Fernandez et al. (2015), Anzuini et al. (2020), and Popiel (2020), we estimated these fiscal reaction function equations for Iran using a particle filter. The results that separated the two types of fiscal policy shocks are illustrated in Figures 6 and 7.

We measured the fiscal policy uncertainty index in Iran, which is illustrated in figure 6.

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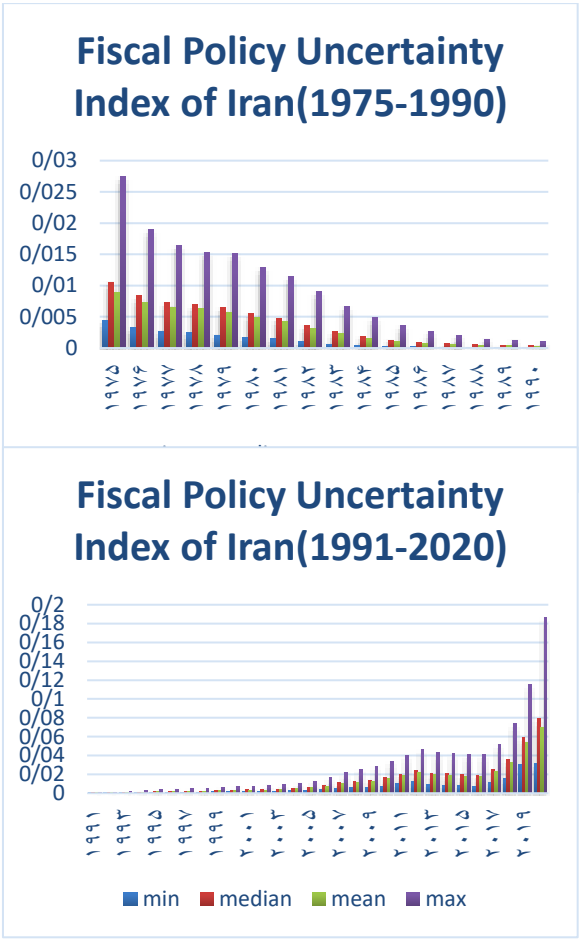

Figure 6. Fiscal Policy Uncertainty Index in Iran
Source: Authors' calculations

According to the results illustrated in figure 6, in the aftermath of the oil revenue boom in 1974, the uncertainty index of fiscal policy in Iran has commenced its increase, and then, during the Iraq-Iran war, the index was high. As mentioned in the fiscal reaction function, during the war period (1980-1988) and after sanctions in 2010 were included as dummy variables, and then we measured the uncertainty index of fiscal policy in Iran.

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Nevertheless, during the Iraq-Iran war, we faced the uncertainty of fiscal policy in Iran. In the wake of the ceasefire, the uncertainty effect gradually decreased, and in the 1990s, the uncertainty index of fiscal policy decreased. Again, the increasing trend of the fiscal policy uncertainty index in Iran has been from the 2000s in 2005. In 2012, the intensification of economic sanctions led to the increasing uncertainty index for fiscal policy in Iran.

Between 2012 and 2016, the trend of the uncertainty index for fiscal policy in Iran slightly decreased, so that the uncertainty index of fiscal policy in Iran is relatively high (maximum 0.04). Since 2017, the uncertainty index of fiscal policy in Iran has increased rapidly to its maximum in 2020 (maximum 0.19), which was unprecedented since 1979.

The uncertainty index for fiscal policy in Iran is high when we compare it e.g., with Anzuini et al. (2020), who measured the maximum of uncertainty index of fiscal policy for Italy (about 0.04) in the worst situation.

Next, we will address the trend of fiscal level shocks (fiscal policy) alongside the accompanying fiscal policy uncertainty.

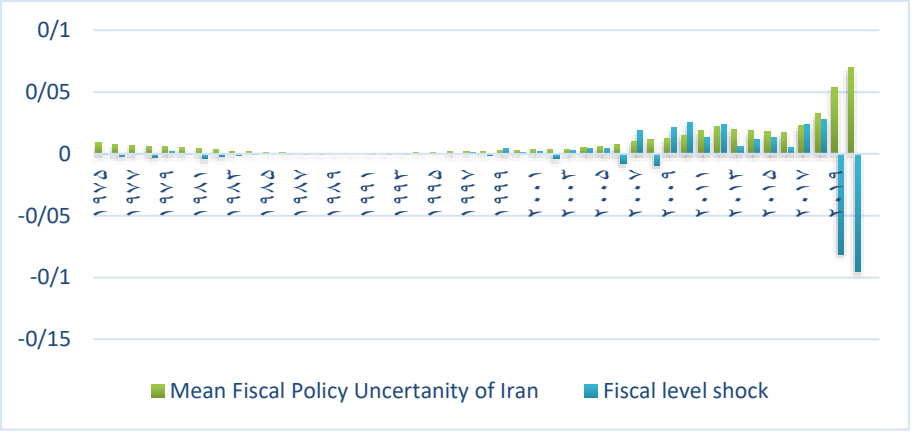

Figure 7. Fiscal Level Shock and Fiscal Policy Uncertainty in Iran
Source: Authors' calculations

According to the results illustrated in Figure 7, in the 2000s, the positive growth of fiscal level shocks generally offset the negative effects of fiscal policy uncertainty (with the exception of 2006 and 2008). However, in the 2010s, since 2012, with the intensification of economic sanctions imposed on Iran, fiscal policy uncertainty has surpassed fiscal level shocks. This situation

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worsened significantly in 2019 and 2020, as the fiscal level shock turned negative (-0.08) and the mean fiscal policy uncertainty continued its positive upward trend, reaching a peak in those years (+0.06).

Given the government budget deficit in Iran over the past decades and its reliance on unsustainable financial resources to finance it (instead of financial discipline and sustainable long-term revenue sources), the uncertainty surrounding the budget deficit has intensified. In the 1980s and 1990s, government budget deficits were financed through an increase in the monetary base and borrowing from the banking system, which led to high inflation and financial instability.

In the 2000s until the first half of the 2010s, the budget deficit was financed by the divestiture of state-owned enterprises and withdrawals from the Oil Stabilization Fund and the National Development Fund. However, since 2016, following the decline in oil exports and instability in oil revenues due to sanctions—particularly during 2018, 2019, and 2020, when the government faced a significant budget deficit—there has been a shift toward extensive issuance of debt securities to finance the government budget deficit. The amount reached an unprecedented level in Iran's economic history as of the end of 2020, with the issuance of 2,700 trillion rials in government debt securities.

The issuance of debt securities, which is considered an unsustainable source of budget revenue (accounting for about 42% of the government's budget revenue in 2020), has been a source of fiscal uncertainty regarding the timing and method of government debt repayment.

7 Concluding Remarks

We employed the fiscal reaction function to measure the uncertainty index of fiscal policy in Iran. As a dependent variable, we utilized government's structural budget balance, which we measured. The findings suggest that the trend of budget balance or deficit has a compliance with the trend of structural budget balance deficit, indicating that the government budget is a structural one.

The fiscal policy reaction can be as a discretionary decision and policy in the structural budget rather than as an automatic stabilizer and react to the output gap in the cyclical budget balance.

The results indicated that the fiscal policy uncertainty index in Iran during the 2010s increased since 2005 and reached a maximum in 2012 due to the intensification of sanctions. The uncertainty index of fiscal policy has also increased since 2012. Then, the trend of the index mildly decreased to 2016,

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so that the level of the index is relatively high. Since 2017, the index has increased rapidly until it reached its maximum in 2020. Such a high level of uncertainty index for fiscal policy was unprecedented since 1979.

Additionally, in the 2000s, the positive growth of fiscal level shocks was able to largely offset the negative effects of fiscal policy uncertainty. However, in the 2010s, starting in 2012, with the intensification of economic sanctions against Iran, the negative effects of fiscal policy uncertainty began to outweigh the positive effects of fiscal level shocks. This situation has deteriorated in 2019 and 2020, as we witnessed a shift from positive to negative fiscal level shocks, aligned with high uncertainty surrounding the fiscal policy.

Overall, the result of these two effects reveals the negative impacts of the government's fiscal policy in Iran, especially when we consider the uncertainty associated with fiscal policy during the 2010s.

The origin of fiscal policy uncertainty could be sought in Iran's budget reliance on oil revenue, which generates the monetary base. Following the oil boom in 1974, Iranian policymakers implemented expansionary fiscal policy, as evidenced by the persistent budget deficits, which have increasingly intensified over time. Consequently, Iran's budget deficit has evolved from a cyclical deficit associated with the output gap to a structural and chronic deficit.

Over the eight years of the Iran-Iraq war, we faced the fiscal policy uncertainty, which diminished gradually the war effects on the uncertainty after the ceasefire. It is noteworthy that the observed downward trend in Iran's fiscal policy uncertainty index during the war period (1980-1988) is due to the inclusion of the war's effects (as a dummy variable) in the model and the fiscal reaction function before measuring fiscal policy uncertainty. After the war, in the 1990s, the fiscal policy uncertainty index decreased significantly.

In the 2000s, despite the establishment of the Oil Stabilization Fund following Iran’s third development plan, the fund lost its intended role. It was meant to prevent oil and foreign exchange revenues from entering the government budget and to allocate them instead to development and infrastructure projects. However, the impact of oil revenue fluctuations on Iran’s economy was not taken seriously as the main source of fiscal policy uncertainty. This claim is supported by the significant oil revenues during the 2000s, which coupled with the government's expansionary fiscal policy and the implementation of the Targeted Subsidy Plan, which involved the allocation of cash subsidies to individuals rather than increasing the share of oil revenues in the sovereign fund of Iran.

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In the 2010s, due to the dependence of the government's budget on oil and foreign exchange revenues, the intensification of sanctions led to heightened uncertainty in Iran's oil revenues. This, in turn, exacerbated the budget deficit and significantly increased uncertainty in the fiscal policy. Notably, in 2012, with the escalation of international sanctions on Iran's oil exports and the subsequent decline in government foreign exchange revenues, the fiscal policy uncertainty index reached its highest level. Following the agreement on the Joint Comprehensive Plan of Action (JCPOA) and the easing of sanctions, the fiscal policy uncertainty index experienced a slight decrease.

The renewed upward trend of the fiscal policy uncertainty index from 2017 can be explained by the U.S. withdrawal from the JCPOA and the re-imposition of sanctions against Iran. This led to reduced international engagement, a decline in foreign exchange revenues, and increased instability in Iran's foreign currency market. The government's shift toward policies like allocating foreign exchange at concessional rates further intensified fiscal uncertainty. The rising exchange rate and the spread between official and market rates, exacerbated by the government's policy of providing foreign exchange with concessional rates for staple goods, contributed to the growing government budget deficit. This is because the government played the role of allocator and provider of foreign currency for staple goods and other items, using concessional and NIMA exchange rates.

We were not witnessing structural budget reforms because, having oil revenues, there was no perceived need for reform in budget revenues until the intensification of oil sanctions in the 2010s. Despite the establishment of the oil reserve fund after the third development plan in Iran and during the 2000s, the fund's role was undermined in preventing oil revenues to add to the current budget of the government instead of directing oil revenues towards development and infrastructure projects. Therefore, the shocks and fluctuation of foreign exchange revenues and its role as the primary source of fiscal policy uncertainty have not been adequately addressed. This is evident from the significant oil revenues in the 2000s and the intensified expansionary fiscal policy, which involved injecting oil revenues into the economy and allocating inflationary cash subsidies to individuals instead of increasing the annual share of the Oil Stabilization Fund and decreasing the dependence of current budget on the oil revenues. Due to the high dependence on oil revenues, the intensification of sanctions in the 2010s led to the uncertainty of Iran's oil revenues, which in turn exacerbated the government budget deficit and significantly increased fiscal policy uncertainty.

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Policymakers need to monitor the fiscal policy uncertainty index developed in this research to measure the uncertainty surrounding government fiscal policies. This index provides a valuable tool for assessing and navigating the uncertainty in fiscal policy, helping policymakers make informed decisions.

Based on the conclusion, we have the following recommendations:

First, given the alignment of the total government budget balance with the structural budget balance and the implementation of discretionary policies that have increased during the period of intensified sanctions, the government's effort needs to be directed towards gradually shifting the nature of the budget deficit from a structural to a cyclical deficit. To this end, the government may reduce the dependency of the government's budget deficit on oil revenues. Moreover, the government may reduce discretionary decisions regarding budget allocation. In this way, the budget deficit will only be allowed to the extent of the output gap.

Second, to control and minimize fiscal policy uncertainty, the government can monitor, and conduct an annual review of the factors affecting fiscal policy uncertainty based on the proposed index.

Third, efforts to undermine the adverse effects of economic sanctions. Reducing the impacts of economic sanctions will decrease uncertainty in oil revenues, which in turn will significantly reduce fiscal policy uncertainty in Iran. This would resemble the situation before the 2010s when fiscal policy uncertainty was not exacerbated by increased sanctions.

Fourth, to approve a fiscal rule in the annual budget to reduce fiscal policy uncertainty. For this purpose, the appropriate fiscal rule experienced by other countries can be extracted from the International Monetary Fund database on fiscal rules of countries.

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Appendix (1)

A) Personal income tax and social security contributions

The method used to derive the GDP elasticities for personal income tax and social security contributions can be summarized as follows. Let Y, T, L and w, respectively, denote output, tax proceeds, employment and the wage rate. The tax elasticity α is defined as:

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$$\alpha = \frac{\partial T}{\partial Y} \times \frac{Y}{T} = \frac{\partial[(T/L) \times L]}{\partial Y} \times \frac{Y}{T} = \left(\frac{\partial L}{\partial Y} \times \frac{Y}{L}\right) \times \left[1 + \left(\frac{\partial (T/L)}{\partial w} \times \frac{w}{T/L}\right) \times \left(\frac{\partial w}{\partial L} \times \frac{L}{w}\right)\right]$$

Table A.1
Elasticities of income tax and social security contributions

Real wage elasticity of				**Output elasticity of**	
Income tax Per worker	Social security contributions per worker	Output elasticity of employment	Employment elasticity of wages	Income tax	Social security
A		B	C	D = B*(1+A*C)	

Table A.2
Estimated short-run output elasticities of employment

Equation: log (L/L*) = a0 + a1 TIME + a2 log (Y/Y*) where L, L*, Y and Y* are actual and potential employment and output, respectively

Table A.3
Estimated short-run employment elasticities of real wages

Equation: log (wL*/Y*) = b0 + b1 TIME + b2 log (L/L*) where w = real wage,L* = potential employment, and Y* = potential output

B) Corporate income tax

The elasticity for the corporate income tax is based on the assumption that the tax rate is strictly proportional, such that cyclical variations in the tax yield correspond to fluctuations in the tax base, i.e. corporate income. If Z denotes corporate income, the corporate tax elasticity can be broken down as follows:

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$$\alpha = \frac{\partial T}{\partial Y} \times \frac{Y}{T} = \frac{\partial Z}{\partial Y} \times \frac{Y}{Z} = \frac{\partial (Y - wL)}{\partial Y} \times \frac{Y}{Z} = \left[1 - \left(1 - \frac{Z}{Y}\right) \times \left(\frac{\partial L}{\partial Y} \times \frac{Y}{L}\right) \times \left(1 + \frac{\partial w}{\partial L} \times \frac{L}{w}\right)\right] \times \frac{Y}{Z}$$

Table B.1
Elasticities of corporate tax

Profit share in GDP	Output elasticity of employment	Employment elasticity of wages	Output elasticity of corporate tax D= {1-(1-A)*B*(1+C)}/A
A	B	C	

C) Current primary expenditure

Current primary expenditure (G) of general government is assumed to fluctuate in proportion with unemployment-related expenditure. So, if U is unemployment, UB unemployment benefits and Ls labour supply, the appropriate formula reads:

$$\beta = \frac{\partial G}{\partial Y} \times \frac{Y}{G} = \left(\frac{UB}{G}\right) \times \left(\frac{\partial UB}{\partial Y} \times \frac{Y}{UB}\right) = \left(\frac{UB}{G}\right) \times \left(\frac{\partial U}{\partial Y} \times \frac{Y}{U}\right) = \left(\frac{UB}{G}\right) \times \left(\frac{\partial L^* - \partial L}{\partial L} \times \frac{\partial L}{\partial Y} \times \frac{Y}{U}\right) =$$

$$= -\left(\frac{UB}{G}\right) \times \left(\frac{\partial L}{\partial Y} \times \frac{Y}{L}\right) \times \left[\left\{\left[1 - \left(\frac{\partial L^*}{\partial L} \times \frac{L}{L^*}\right)\right] \Big/ \left(\frac{U}{L^*}\right)\right\} - 1\right]$$

Table C.1
Estimated short-run employment elasticities of the labour force

Equation: log (Ls/L*) = c0 + c1 TIME + c2 log (L/L*) where Ls = labour suply, L and L* are actual and potential employment

Source: Van den Noord, OECD, 2000.

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