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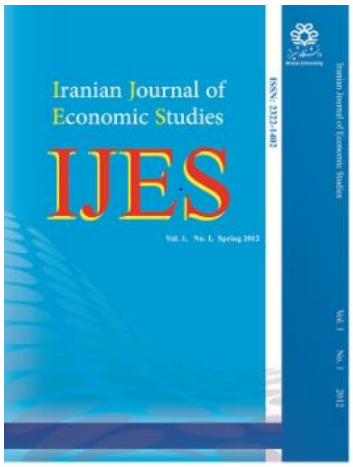

Subject of manuscript

Analyzing Tax Incentives Effects in the Partial and General Equilibrium Framework : the case of Iran

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Iran.Doi: 10.22099/ijes.2022.43386.1823

To appear in: Iranian Journal of Economic Studies

Received Date: 27 March 2022

Revised Date: 14 September 2022

Accepted Date: 26 October 2022

Please cite this article as:

Rezaei, E. (2022). Analyzing Tax Incentives Effects in the Partial and General Equilibrium Framework : the case of Iran. Iranian Journal of Economic Studies, (), -. doi: 10.22099/ijes.2022.43386.1823

Analyzing Tax Incentives effects in the Partial and General Equilibrium Framework: the case of Iran

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Abstract

Assessing the recent decade's literature outlines that, advanced economies mainly employed temporary tax incentives to spur economic activities after 2007-2008 economic crisis whereas developing countries use broadly them as a normal as well as a permanent fiscal policy to intrigue economy. Among latter group, Iran's fiscal authorities have been using quite an extensive diversity of tax incentives to boost real sector variables such as investment, capital accumulation and output for a long-term period. The methodology is based on the simulating a partial as well as a general equilibrium model. Benefiting from a New Keynesian general equilibrium (NKGE) model, in this research, the comprehensive effects of tax allowances, accelerated depreciation, and tax reduction on the macroeconomic variables (investment, capital, output and consumption) and fiscal measures (government revenues and the present value of the government revenue) have been evaluated. Our findings reveal that, based on the assumption of flexible wages and prices, running tax incentives policy would culminate to considerable budget deficit followed by an unsustainable fiscal stance in the economy. However, imposing nominal rigidities by their special mechanisms brings about positive effects of tax incentives and relatively fiscal sustainability. In other words, introducing rigidities in wages and prices causes positive reactions of mentioned macro and fiscal variables.
JEL: H21, E10; E17; E22; H25.
Key words: Partial and General Equilibrium, Tax Incentives, Iran, NKGE model.

Highlights

- This study benefits from a partial as well as a general equilibrium framework to analyze if the effects of tax incentives are different under each structure.
- The scope of models is capable to simultaneously assess the effects of a set of tax incentives, including tax allowances, accelerated depreciation, and tax reduction.
- The reaction of the fiscal stance is different under various assumptions with regard to nominal variables flexibility.
- Findings of the paper have some useful hints to the government that how they can choose between economy stimulating and fiscal sustainability.

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1.Introduction

A “tax incentive” concept includes quite a broad diversity of tax holidays, allowances, preferences, exemptions, and deferments which appears under several articles in tax codes or investment plans in sundry of heterogenous economies. Based on the degree of tax systems development, these concepts are defined under the name of “tax credit”, “tax deduction”, “super-deductions”, “accelerated depreciation”, “tax rate reduction”, “timing differences”, “reinvestment rules”, “special and subjective incentives such as research and development incentive”, and “free-economic zone-related incentives”. (United Nations, 2018; Holland & Vann, 1998) Some of these reductions, such as tax credits are directly deducted from “tax liabilities” and some of them such as accelerated depreciations are deducted from “taxable income” of a tax payer.

Beyond from the concept of tax incentives, the most controversial aspect of tax incentives is the usefulness degree of these instruments in the economy. In other words, the main question is that whether or not the following condition is met after tax incentive granting;

Investment surge due to the incentive + social benefits ≥ forgone revenue +implementing costs of tax incentives.

Where, “social benefits” are issues such as occupation creation, skill boosting, environment cleaning, health and other positive economic scales. Also, “implementing costs” are management cost of planning tax incentives, misallocation of financial resources and corruption.

Along with the above theoretical statement, James (2013) puts forward a claim that the tax incentives besides some financial and economic costs, impose some negative welfare impact on economy. In addition, the extent of instigating the investment through traditional tax incentives remains vague in most emerging economies. One step ahead, some research in the World Bank clearly reveals the negative impacts of "general tax incentives" on the corporate investment. (World Bank Group, 2020) On the other hand, studies based on the “partial equilibrium” methodology and studies based on the “general equilibrium” discovered some opposite hints. The former models mainly concentrating on the production structure of firms and encompassing just some parts of macro markets certify positive impacts of the incentives. Feltenstein and Anwar Shah (1992), for instance, by maximizing profit of the firms, have investigated the efficiency of some incentives on the firm investment performance. According to this study a precipitous drop in general tax rate was more effective than direct tax credit among the Mexican firms. The latter group of studies employing general equilibrium-based models, such as dynamic stochastic general equilibrium (DSGE) and computable general equilibrium (CGE) models, have almost analogous general findings. Along with this line of research, Edge and Rudd (2011) examined the effects of fiscal rescue plan over 2008 crisis on the American industries. Using the framework of a DSGE model they highlighted that under the sticky prices and wages condition the effect of incentives is greater than the flexible price regime. Besides, Houndonougbo & Mohsin (2016), in another study, comprehended that the tax incentives were able to recover forgone government revenue as well as welfare benefits by intriguing economy. These controversial results mirror to what extent the problem is nebulous.

With regard to the aforementioned discussion, today the main problem is not whether or not the tax incentives should be implemented. The major argument is if the benefits of tax incentives overshadow its costs. This debate in Iran's economy is imperative due to a number of reasons. Firstly, while there is quite a diverse mixture of tax incentives, there are roughly no thorough assessments of their influence on the Iran's economy. Secondly, to choose the best instrument, policy makers constantly have to revise existence policy instruments or design new ones. However, without some reliable empirical research how they can perform this task. Thirdly, coexistence of

a large number of tax incentives might neutralize all positive effects of useful ones. Hence, contradictory incentives have to be recognized.
Besides all necessary considered points, the remaining issue is finding an appropriate approach to evaluate the final effects of tax incentives. To carry out a comparable analysis for each incentive or group of similar incentives, we have to adopt a two-stage modeling in partial and general equilibrium.
To empirical assessment of the mentioned disputed argument in Iran's economy we will employ a DSGE model to investigate the main question of distributional and macroeconomic effects of tax incentives. To this purpose, the second section represents the theoretical points of the subject. Establishing a practical framework to assess the consequences of the policy making is the discussion of the third part. The next issue would be the empirical analyzing and simulation of the data. The final discussion would cover the conclusion remarks.

2. Theoretical Background

Based on the literature, it is roughly clear that the effects of tax incentives on the real economy mainly pass through investment channel. (Sebele-Mpofu et al., 2022) However, it is worth noting that almost all economists, before presenting their theoretical viewpoints in relation to the effectiveness of tax incentives on the investment and other real sector variables, outline some granted imperative assumptions such as; a) existing efficient infrastructures like physical and financial facilities, b) no chronic corruption and transparent regimes of laws and regulations, c) presenting guarantee for ownership rights, contracts validity and the principal property of investor, d) macroeconomic stability that is particularly to say no instability in general prices level, budget deficits, exchange rate high fluctuations, and trade huge imbalance, e) political stability, f) an accountable and transparent tax system. (Fadejeva & Tkacevs ,2022; Holland & Vann,1998) It is obvious that there would be no room for discussion about tax incentives in case of lacking mentioned assumptions. (Holland & Vann,1998; Zee et al., 2002)

Partial equilibrium analysis: The eminent theoretical framework to examine investment behavior is the Jorgenson (1963) theory. The central pivot of this theory is that as long as the profit of the marginal unit of investment is greater than its marginal cost the investing will continue. The investment comes to halt when the rate of investment return becomes equal with its cost. By this interpretation the rate of investment return was adopted as "cost of capital" and economists incepted to measure this concept, practically.

Among factors affecting cost of capital, taxation has attracted increasing attention of the most studies. According to this inference, if tax change is effective in plunge of cost of capital, it will significantly determinant in investment surge. Hence, based on this theory to measure the shift of investment it would be enough to capture the effect of tax change on the cost of capital. In addition, this issue paved the way for the marginal effective tax rates (METR) calculation. Notwithstanding, some complications in developing economies cause difficulties in using METR in analyses. Since, employing quite a broad range of tax holidays in their taxation, these countries policy brings about some ambiguity in mentioned rates in terms of their effects on cost of capital as well as corporation profits. (Mintz, 1990).
After the advent of the "cost of capital" concept, the initial studies about the relation between the cost of capital and investment were not able to conclude consistent with the theory prediction and

there were mainly no relationship or opposite direction between the two variables. (Auerbach & Hassett, 1991; Cummins & Hassett,1992). These paradoxical results were the main reason for Blanchard (1986) to hint the schism between the theory and practice in investment issue as an apex of paradox in macroeconomic literature. However, by further attempts of other economists (Goolsbee,1998; Dixit & Pindyck, 1994; House & Shapiro, 2004) in various aspects of research, including; correcting modeling, data gathering, and revision in definitions, the gap was roughly bridged.

General equilibrium analysis: Building macro models based on micro foundations for the tax policy analysis has been growing over the last decade. This advancement provides a possibility of linking all markets to each other to scrutinize the consummate effects of the encouraging policies. In a harmonious line with a mentioned literature, House et al. (2019) using an open economy general equilibrium framework, represent that tax incentives are able to provoke some macro variables such as wages, investment and employment up to a certain point of output increase. They disclose that by observing some conditions such as splitting purchased capital into imported from foreign countries and domestic produced it can be pointed out that the effects of tax incentives on the capital accumulation would be greater than employment or economic growth change.

Another underlying argument in favor of the later advancement in theory belongs to Drygalla et al. (2017) who pointed at the positive but small impact of discretionary fiscal policy on the Germany's economy. Also, Zwick & Mahon (2017) emphasizing on the heterogeneous aspects of firm's size, illustrate that, compared with all covered firms, the small-sized units are more influenced by the government's plan. This study attaches more importance to the cash flows' role of incentives.
Along with the above theoretical line, Romer (2012) highlighted that in case of economic recession tax incentives would be influential to stir the economy up. According to this theory, a permanent tax credit can shift up the long-run path of firm's capital stock.

Geographical-based theories: Despite above general equilibrium literature and more efforts to highlight the validity of the Neoclassical investment theory's prediction (Jorgenson's theory), there was a relatively growing opposite literature under the name of a "New Economic Geography Theory" or "Core-peripheral Models" which put emphasis on the ineffectiveness of tax incentives on the capital movements from "north" to the "south" regions. These points of view, which can mainly be found in Krugman's studies (1991, 2000), express that the north regions by absorbing more fugitive and fluid capitals through "market- access effect" and low "cost of living effect" would be able to keep a copious volume of capital in comparison to the south regions where would probably be able to absorb only basic industries (capital). In fact, according these theories, the geography and its features would surpass the possible positive effects of the tax incentives.
In general, considering gradually converging beliefs of the partial and general evaluations on one hand and other rival views (such as just mentioned Core-peripheral Models) on the other, leads us towards conducting more empirical research to shed light on the challenge.

3. Model

In this section, using a New Keynesian General equilibrium (NKGE) model the partial and general equilibrium effects of tax incentives will be evaluated on the investment and other real variables

of the Iran's economy. Based on the adopted methodology, after forming the model, it will be solved to attain the equilibrium dynamics by specifying an approximation to the function in terms of variables and coefficients. This approximation (linearization) can be performed in the level of the state variables or after applying some change (log-linearization) of variables. After, suppressing stochastic components and working with steady-state variables, all under consider simulated variables will be confronted with actual data. Then, using some criteria the accuracy of simulations will be assessed. To complete analysis, impulse-response functions will be finally applied to appraise the reaction of endogenous variables.

In NKGE model it would be probable that some features such as the sticky wages and prices and the nominal frictions of other variables provide some situation where the general effects of policy become different from the partial effects. In addition, linking micro-macro markets provides a context on which to consider the response of macroeconomic variables to the tax incentives shocks, the model will be based on the behavior of households, firms and government. Also, there are some salient points about our model including;

a) We will initially evaluate the partial equilibrium using some key relations and this paves the way for general equilibrium analysis under the two different sticky and flexible prices and wages assumptions.

b) The variety of tax incentives which will be used in the analysis are; tax allowances for new investment expenditure, depreciation acceleration based on the Iran's Direct taxes code, and finally dropping in taxes on the capital and labor revenues. By tax allowances, in this paper, we mean that the investors are permitted to deduct the new invested money from their taxable income.

c) The adjustment costs such as installing new equipment would be introduced into capital and investment equations to bring more reality for analysis.

d) Taking into account the stylized fact of no independency in central bank's decision making and complex relationship between the government's budget deficit and its financing through publishing new money base by central bank in the Iran's economy, brings about some modifications in the standard New Keynesian General Equilibrium (NKGE) model. The most important one is introducing the budget deficit in the central bank's monetary equation. It is worth noting that with regard to the crucial role of interest rate targeting in monetary managing, the model will include the interest rate equation, too.

e) In this model, families are capital owners and they rent the capital to intermediate goods producers. The final goods producers use the intermediate goods in the production process.

f) The only way to forge a relationship between domestic and international markets is oil and gas exporting.

g) This step-by-step modeling, also, intensifies the robustness of the results.

3.1 The model

The Keynesian model has three distinguished agents; households, firms, and the government. In this model a long chain of families consume the production of economy and at the same time supply the workforce of the labor market and lease their capital. There are two groups of firms: intermediate goods producers and final goods producers. The government has two roles in the model; fiscal and monetary policy making.

3.1.1 Households

The preference of agent family, based on Edge, and Rudd (2011) study**,** would be represented through following utility function;

$$U_0 = E_0\left\{\sum \beta^t \left[\frac{1}{1-\sigma}(C_t^i)^{1-\sigma} - \frac{1}{1+b}(L_t^i)^{1+b}\right]\right\} \quad (1)$$

Where C_t^i is the consumption of the family, L_t^i is its labor supply, β, σ, and b are the intertemporal preference discount factor, the inverse of substitution elasticity, and the labor supply elasticity, respectively.

The budget constraint of family which indicates for its role in the capital accumulation and labor supply can be specified as follows;

$$a_{t+1}^i = R_t^a a_t^i + R_t^a R_t^k K_t^i - R_t^a \tau_t^k \left(R_t^k K_t^i - inc_t P_t I_t^i - \sum_{v=1}^{\infty} \delta(1-\delta)^{v-1}(1-inc_{t-v})P_{t-v} I_{t-v}^i\right) + R_t^a(1-\tau_t^l)(W_t^i L_t^i + Dividend_t^i) + \bar{TR}_t^i - R_t^a P_t C_t^i - P_t I_t^i, \quad (2)$$

Where rate of asset return, R_t^a , can be defined as;

$$R_t^a = R_t - \tau_t^l(R_t - 1) \quad (3)$$

Also, a_t^i is the nominal wealth of the family at the beginning of time t, W_t^i is the nominal wage paid to the labor, R_t^k is the rent of capital (K_t^i)paid to the families, capital would be depreciated by the rate of δ, $Dividend_t^i$ is the distributed profit of capital market from the intermediate producer firms to the families, $\bar{TR}_t^i$is the lump-sum transfer payments from the government to the families, $P_t$is the price of final goods, I_t^i is the investment goods purchased by the families, $R_t$is the nominal gross interest rate between t and t+1 periods.

The remaining variables of the equations 2 and 3 are related to financial and tax issues. The tax system impose tax on the financial properties, stock and the labor income at τ_t^l rate and the capital income at τ_t^k . Based on the equation 3, the families receive the net return of their properties by R_t^a. In fact, this equation reveals that just the return of capital not capital (principal) would be taxed by the government. Besides that, there are two other deductible items; depreciation costs and allowances related to investment expenditure. The compelling reason behind the reduction related to the depreciation is due to the compensating of depreciation expense of the rented capital by the families which is usually finances by the obtained rent income.

According to the Neoclassical theory of investment, in equation 2 , inc_t , shows total incentives which is deductible from whole new investments expenditure, $P_t I_t^i$, at time t. likewise, the monetary value of depreciation which accumulated from previous periods could be represented by $\sum_{v=1}^{\infty} \delta(1-\delta)^{v-1} P_{t-v} I_{t-v}^i$. However, it might be possible that over previous periods all expenditures on investments were not be under allowances so the $P_t I_t^i$ is multiplied in $1 - inc_{t-v}$. The subscript $t-v$ indicates that the depreciation starts to be calculated from the installing time of v. One important point is why δ is multiplied by the investment. The clear reasons behind this multiplication are the necessity of calculation of the value of previous depreciations at time t and the deductibility of depreciation expense from investment instead of capital. In other words, expensed capital cannot receive a depreciation allowance whereas investment is the only reasonable variable for this deduction. It is worth noting that a deduction δ from K reduces the

receiving of the family whereas multiplying δ by I_t^i returns previous expenses in the form of allowance.

In practice, the rate of depreciation is not calculated by (δ) instead it would be based on the "Direct Tax code" of Iran. In this model, the necessity of employing statutory rates of depreciation is the primary cause of using $\sum_{v=1}^{\infty}\delta(1-\delta)^{v-1}P_{t-v}I_{t-v}^i$ instead of $\sum_{v=1}^{V}\delta_v^{irs}P_{t-v}I_{t-v}^i$. Where, the δ_v^{irs} is the statutory rate and is modeled as $\delta_v^{irs}=\delta(1-\delta)^{v-1}$to reduce the number of new parameters. In case of substitution real depreciation and statutory one it would be clarified. The symbol v denotes the economic life of property.

In absence of adjustment costs, the law of capital motion would be disclosed by;

$$K_{t+1}^i=(1-\delta)K_t^i+I_t^i\,exp(\vartheta_t^{\Delta k}) \quad (4)$$

Where $\vartheta_t^{\Delta k}$ implies the efficiency shock on the investment.

However, in reality the adjustment costs affect the investment and capital decisions, so there would be two forms of equations in which these costs will impact capital and investment as follows, respectively.

$$K_{t+1}^i=(1-\delta)K_t^i+I_t^i\,exp(\vartheta_t^{\Delta k}-\frac{\omega^k}{2}(\frac{K_{t+1}^i}{K_t^i}-1)^2) \quad (5)$$

$$K_{t+1}^i=(1-\delta)K_t^i+I_t^i\,exp(\vartheta_t^{\Delta k}-\frac{\omega^{\Delta k}}{2}(\frac{I_t^i}{I_{t-1}^i}-1)^2) \quad (6)$$

Where, $\omega^k$and $\omega^{\Delta k}$ allude the curvature degree of capital and investment functions, respectively. It is evident that in simulation process and impulse-response functions analysis we use each one separately not both at the same time. This utilization is part of our comparison practice. In other words, an important idea behind this kind of specification is assessing the exact effect of adjustment costs in investment process in the Iran's economy.

The other important assumption related to families is taking into account the effects of stickiness of wages so that on each period just $1-\gamma$ percent of families are able to adjust their wages and other remaining γpercent would not be able to change the wages.

According to above description about families, one can state that the agent family would be able to choose the value of $\{C_t^i,W_t^i,L_t^i,I_t^i,K_{t+1}^i\}_{t=0}^{\infty}$variables in order to maximize the utility function subject to constraints (2), (3), (5), and (6). It is obvious that the general level of prices, P_t, the nominal gross rate of interest, R_t, the rental rate, R_t^k, the initial value of wealth, a_0^i, in concomitant with the statutory tax and allowance rates, τ_t^l, τ_t^k, $inc_t$are given.

3.1.2 Firms: the production of intermediate and final goods

The j[th] producer firm of intermediate goods in monopolistic competition market chooses the distinguishable labor force, $L_t^{i,j}$, and capital, K_t^j, so that the cost of production, Y_t^j , plunges to its minimum level. This agent firm will take the wage rates, W_t^i, rental rate of capital, R_t^k, and the production function as predetermined arguments. In other words, the j[th] firm will minimize the below cost function;

$$\min_{\{L_t^{i,j},K_t^j\}_{t=0}^{\infty}}\int_0^1 W_t\,L_t^{i,j}\,di+R_t^kK_t^j$$

s.t.

$$\left(\left(\int_0^1 L_t^{i,j\,\frac{\phi-1}{\phi}}\,di\right)^{\frac{\phi-1}{\phi}}\right)^{1-\alpha} (K_t^j)^{\alpha} - TFC \geq Y_t^j \qquad (7)$$

Where, α indicates to share of capital, TFC denotes fixed cost which equals $TFC = \frac{Y_*}{\theta-1}$. The minimization problem implies to the labour and capital demands as well as marginal cost, MC_t^j. Demand functions for variety of distinctive labor would be shown by $L_t^i = L_t(W_t^i/W_t)^{-\phi}$ where the total wage, W_t, is defined by $W_t = \left(\int_0^1 (W_t^i)^{1-\phi} dz\right)^{\frac{1}{1-\phi}}$.

It is assumed that the producer of intermediate goods can be price setter so that in each period only $1-\eta$ percent of firms can change their output prices and the remaining η percent will not be able to change. This alludes to the stickiness of prices in this section.

The final goods producer takes the intermediate goods price, $(P_t^j)_{j=0}^1$ and chooses the intermediate goods, $\left(Y_t^j\right)_{j=0}^1$, to minimize the cost of final goods production, $\left(Y_t\right)$, as follows;

$$\min_{\{Y_t^j\}_{t=0}^{\infty}} \int_0^1 P_t^j Y_t^j\, dj \quad \text{s.t } Y_t \leq \left(\int_0^1 Y_t^{j\,\frac{\theta-1}{\theta}}\, dj\right)^{\frac{\theta}{\theta-1}} \qquad (8)$$

Through minimizing this function, the demand function for the intermediate goods, $Y_t^j = Y_t(P_t^j/P_t)^{-\theta}$, would be attainable so that the price of final goods, P_t, will be determined by following equation.

$$P_t = \left(\int_0^1 (P_t^j)^{1-\theta} dz\right)^{\frac{1}{1-\theta}} \qquad (9)$$

3.1.3 Monetary policy

According to the theoretical issues central bank aims to manage interest rates and the money level in short-term. Hence, we will try to incorporate the two targets in the model. Initially, we assume that the targeted nominal interest rate, $\bar{R}_t$, would be affected by the deviated value of production and inflation from their long-term values;

$$\overline{R_t} = (^{inf_t}/_{\overline{inf}})^{\emptyset k}\ (Y_t/\bar{Y})^{\emptyset y} R_* \qquad (10)$$

Where, R_*, shows the equilibrium rate of interest. For the sake of simplicity, it is assumed that the long-term output of the economy is set to be $\bar{Y} = Y_*$ by the central bank. The motion path of the real interest rate towards its targeted value would be elucidated by;

$$R_t = (R_{t-1})^{\rho}(\bar{R}_t)^{1-\rho}\, exp(\vartheta_t^r) \qquad (11)$$

The term ϑ_t^r implies the policy shock.

Other specifications of monetary policy can be adopted to control the behavior of exchange rate and other targets of central bank (Nakhli et al, 2020) which are not closely relevant to this study. Along with the other characteristic of Iran's economy in the model, the growth of the money supply would be modeled as;

$$\frac{M_t}{M_{t-1}} = \rho_m(\frac{M_t}{M_{t-1}})_{t-1} + (1-\rho_m)\bar{M} + \rho_{oil}\varepsilon_{oil} + \varepsilon_{\eta} \qquad (1\acute{1})$$

Where, $\frac{M_t}{M_{t-1}}$, is the money growth rate and, ε_{oil}, is the oil revenues shock. This equation outlines the behavior of Iran's central bank which is usually different from the normal behavior in relation

to money controlling around the world. It is clear that both of R_t and M_t will not use as monetary policy instruments at the same time. However, R_t is modeled but the M_t will be used just in the impulse-response function analysis, exogenously.

3.1.4 Fiscal policy

Due to the concentration of this study on taxation, we employ a comprehensive equation for capturing the government behavior[2];

$$G_{1t} + M_{t-1} + \int_0^1 \bar{TR}_t^i di = Rev enue_t$$
$$= M_t + \int_0^1 \tau_t^l W_t L_t^i di + \int_0^1 \tau_t^k R_t^k K_t^i di + \int_0^1 \tau^l Dividend_t^i di$$
$$+ \int_0^1 \tau_t^l (R_{t-1} - 1)(a_t^i / R_{t-1}) di - \int_0^1 \tau_t^k inc_t P_t I_t^i di - \int_0^1 \tau_t^k incb_t^{i,\delta} di \quad (12)$$

The government liability to the families due to tax allowances would be illustrated as;

$$incb_t^{i,\delta} = \sum_{v=1}^{\infty} \delta(1-\delta)^{v-1} (1 - inc_{t-v}) P_{t-v} I_{t-v}^i = \delta(1 - inc_{t-1}) P_{t-1} I_{t-1}^i + (1-\delta) incb_t^{i,\delta} \quad (13)$$

The other variable which is introduced in the model is the discounted value of the government revenue;

$$PDV_t^{rev} = E_t \left[\sum_{v=0}^{\infty} \frac{\beta^v MU_{t+v}/P_{t+v}}{MU_t/P_t} Rev_{t+v} \right] = Rev_t + E_t \left[\frac{\beta^v MU_{t+v}/P_{t+v}}{MU_t/P_t} PDV_{t+1}^{rev} \right] \quad (14)$$

It's dependency to marginal value of consumption, Mu_t, reflects the stochastic feature of the discount factor in obtaining the future revenue values.

Finally, the tax policy is conducted based on an AR process. A tax incentive, for instance, follows below motion law;

$$inc_t = \rho_{inc} inc_{t-1} + \varepsilon_t^{inc} \quad (15)$$

Similarly, the temporary tax allowances can take $MA(n-1)$ process where n is the number of periods;

$$inc_t = \varepsilon_t^{inc} + \varepsilon_{t-1}^{inc} + \ldots + \varepsilon_{t-n+1}^{inc} \quad (16)$$

Along with, the oil revenues are exogenously determined as follows;

$$Oil_t = \rho_{oil} oil_{t-1} + (1 - \rho_{oil}) \bar{oil} + \varepsilon_{oil} \quad (16')$$

3.1.5 Equilibrium condition (market clearing condition)

The resources constraint of economy indicates that;

$$y_t = c_t + g_t + i_t^k \quad (17)$$

Where, g_t indicates final goods consumption by the government.

[2] - the integral symbol shows just the aggregated level of variables.

The solution of the model and linearization (log-linearization) of key equations are reported in the appendix of the paper.

3.3. Calibration of the parameters

After log-linearizing the model (represented in the appendix), the next stage is describing the variables and parameters to implement the empirical assessment. To this end, table 1 and 2 summarize all variables and parameters which are used in the model to appraise tax incentive effects. The under-discussion period covers from 1990 to 2016. This period, in fact, excludes the most unstable conditions of sever last economic sanctions and the 1980s Iran-Iraq's war.

Table 1- summarizing variables

Symbol of variable	description	Symbol of variable	description
C_t^i	The family consumption	W_t^i	Nominal wage
L_t^i	The labor supply	R_t^k	Capital rate of return (received by family)
a_t^i	The nominal assets(wealth)	K_t^i	capital
$dividend_t^i$	Stock profit	P_t	Final goods price
I_t^i	investment	R_t	Before tax interest rate
R_t^a	After tax assets rate of return	inc_t	Tax incentives
Y_t^j	Intermediate goods	Y_t	Final goods
V	Useful life long	MC_t^j	The final cost
$\bar{R}_t$	The targeted interest rate	$Mg = \frac{M_t}{M_{t-1}}$	Money supply growth rate
M_t	Money stock	oil_t	Oil revenues
$incb_t^{i,\delta}$	The government debt for tax incentives	TFC	Fixed cost
PDV_t^{rev}	The present value of the government revenues	MU_t	The marginal utility of consumption
$T\bar{R}_t^i$	Transfer payments to families	PDV_t^{δ}	The discounted present value of future tax incentives
$\bar{M}$	Long-term money level	$\bar{Y} = Y_*$	Long-term output
R_*	Long-term interest rate		

Source: summarized from the model and all related data were taken from Iran's central Bank's Database

Table 2– calibrated parameters

Symbol of parameters	description	Calibrated value	source
α	Capital share	0.43	Rezaei (2022)
σ^{-1}	Intertemporal elasticity	0.65	Rezaei (2022)
φ	The elasticity of labor substitution	1.45	Rezaei (2022)
θ	The elasticity of intermediate goods substitution	4.33	Shahmoradi and Ebrahimi (2010)

δ	Depreciation rate	0.042	Shahmoradi and Ebrahimi (2010)
β	Subjective discount rate	0.98	Rezaei (2022)
ω^k	The curvature degree of adjustment cost(capital)	2	Khiabani (2016)
$\omega^{\Delta k}$	The curvature degree of adjustment cost(investment)	2	Khiabani (2016)
$1-\gamma$	The percentage of families who can change their wage	0.3	Shahmoradi et al. (2011)
$1-\eta$	The percentage of families who can change the prices	0.3	Shahmoradi et al. (2011)
b	The inverse of labor supply elasticity	2.17	Taee (2007)
τ_*^l	The tax rate on other income	0.06	Research findings
τ_*^k	The tax rate on capital income	0.33	Research findings
$\bar{inf}$	Targeted inflation	1	-
$\bar{oil}$	Long-term oil revenues	40	Research findings
ρ_{oil}	Parameter in oil equation	0.5	Research findings

Source: research findings

4. Empirical results and impulse-response functions analysis

In this section, the discussion will point to two kinds of analyses. The first will be a comparison based upon the long-term (steady state) values of key variables. According to this comparative assessment we will weigh up the key moments of the key variables produced by the model and those which obtained from actual data. The more analogous results, the more validity of the modeling. The second method of investigation will be grounded on the impulse-response analysis. Based on this practice, we will assess the reaction of key variables to some exogenous (permanent or temporary) shocks of policy variables.

4.1 The comparison between simulated and actual data

After calibration of the parameters, the other group of variables which have to be simulated, based on the model, or calculated, grounded on the actual data, are those which supposed the key variables in terms of the research statement of problem. This comparison will determine the model's goodness of fit.

In order to detrending of the actual data there are some arbitrary measures which can be employed to detrend these variables. We chose an adapted measure to transform actual data which is more comparable with the model-produced data. Our measure takes the following formula;

$$J_t = \left(\frac{X_t}{L_t^{1-\alpha} K_t^{\alpha}}\right)^{\frac{1}{\alpha}} \qquad (18)$$

Where, J_t is the detrended variable (X_t) in terms of effective labor factor (L_t).

In order to detrending actual data we used prementioned variables over the 1990-2016 period.

The table 3 delineates the two groups of simulated and actual data for the key variables of the research. The results appear to propound that, a part from investment which outlines more fluctuations the other variables keep closeness in terms of model's outcome and data calculation.

Investment in equipment and machinery reveals more fluctuations because of the nature of this variable as well as its dependence on the international variables. (Volume of import and exchange rate fluctuations) Generally, from the information supplied, the outcome shows higher validity of modeling to simulate the Iran's economy's behavior.

Table 3- the steady state values of variables

Symbol of the variable	description	The Value – based on actual data	The Value – based on model	The comparison criterion (ratio of standard deviations)	
				data	model
oilbar	Oil revenues to GDP	0.119	0.096	0.06	0.08
cybar	Consumption to GDP	0.65	0.63	0.08	0.07
revybar	Taxes to GDP	0.07	0.08	0.05	0.03
rbar	The long-term interest rate	0.11	0.09	0.009	0.008
kbar	Capital to GDP	3.82	3.05	0.03	0.06
ibar	The private sector investment to GDP	0.03	0.01	0.17	0.25
WSS	Wage index	1.23	1.17	0.004	0.007

Source: research findings

4.2 The impulse-response functions

In order to investigate the dynamic features of variables which impose shocks to the model, the impulse-response functions analysis will be incorporated. On these figures the horizontal axis shows the time and the vertical axis depicts the percentage change in the endogenous variable from its steady state value against one (or more) deviated standard shock(s) on the policy variable.

Introducing several assumptions in the model create different versions of the model those have to be considered to clarify the effects of incentives influence. The most important assumptions are: including the adjustment costs in investment and capital equations, temporary or permanent alterations in the policy variables, stickiness or flexibility in wages, prices or both of them, and nominal or real variables in the model. Based upon these assumptions we will have following frameworks:

a) The partial equilibrium model (including the adjustment costs);
b) The general equilibrium model (covering the real variables and adjustment costs)
c) The general equilibrium model (temporary or permanent alterations in policy variables, stickiness or flexibility in wages, prices or both of them)

4.2.1 The partial equilibrium

The primary reason behind employing the partial equilibrium model is forging a sound and step by step model towards a general equilibrium as well as providing a situation to compare the results of two distinctive models. In fact, this model is not more than using the neoclassical investment theory and fixing the nominal and real rate of interests at a constant value. With gradual

generalizing of the model the effects of changing some variables such as interest rates, investment demands and consumption will be appeared. In other words, the effects of tax allowances in the partial equilibrium will be evaluated while we do not consider consumption, nominal and real interest rates, prices and wages, temporarily. Therefore, all endogenous variables which will be introduced to the model are;

The capital in t and t+1 (K_{t+1}^{i},K_{t}^{i}), accelerated depreciation (pdvdep_{t}), investment (I_{t}^{i}), production (Y_t), government revenues (rev_t), the present value of government revenues (PDV_t^{rev}), the liability arises from accelerated depreciation ($incb_t^{i,\delta}$), government expenditure (G_t), and money level (M_t).

In addition, all imposing shocks would be; temporary or permanent tax allowances shocks, tax reduction shock, oil revenues, government expenditure, and monetary policy shocks.

4.2.1.1The temporary tax allowances shock and the reaction of variables

Given is figure 1 illustrating that after one positive standard shock on tax allowances, the key endogenous variables such as investment (lit) and capital (lkt) positively surge about 0.03 percent. The important point is that due to the flexible wage and prices this pick-up will be turned back to its initial level within 5 periods.

The reaction of the government revenues (rev) and the cost-benefit index (the present value of the government revenue, pdvrev,) in accordance with the theoretical expectation, are considerably negative. The vital point here is that the fiscal variables will not react entirely against the imposed shock. Because in the partial equilibrium analysis some key variables are regarded constant and this impedes potential reflecting of the fiscal variables, particularly tax revenues.

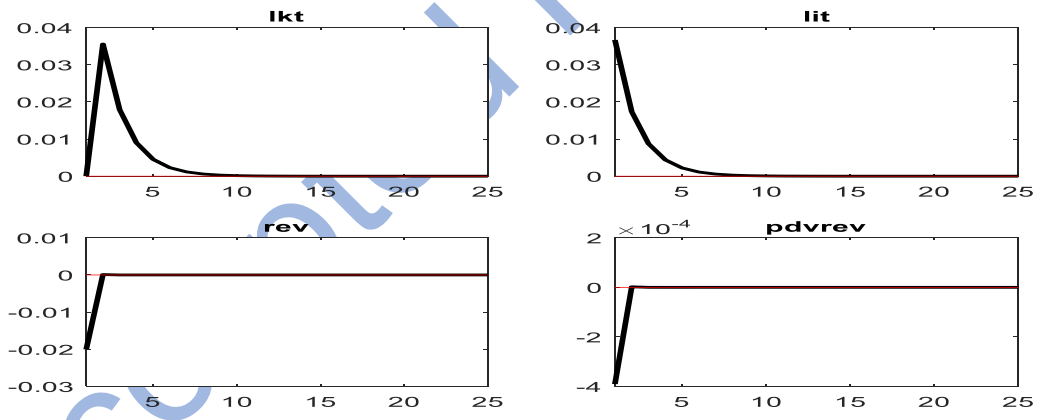

Figure 1- The effects of the temporary allowances in investments on key variables -partial equilibrium

Source: Research findings

4.2.1.2 The permanent tax allowances shock and the reaction of variables

Figure 2 delineates that after imposing the tax allowance shock, the investment (lit) and capital (lkt) start to increase more than 0.1 percent in less than 4 periods and then remain in a new long-term patch.

One important point about the sooner reaction of the capital compared to the investment in Iran's economy is importing intermediate goods in the short space of time which is easier than establishing a new production line.
The other salient point about the difference in slope of reactions in transient and permanent cases is the capital and investment adjustment costs which relatively affect demands more in permanent case in comparison to the temporary situation, and in its result the slope of motion in former case is slower than the latter. In general, this result discloses that the increasing demand for investment after a positive shock of the tax incentives is precluded by the increasing cost of adjustment costs, especially when an investor regards the shock will continue for a long-lasting period.
The third point in the partial eternal equilibrium is appearing a long-term budget deficit (-0.02 percent) as a consequence of expansion fiscal policy.

equilibrium

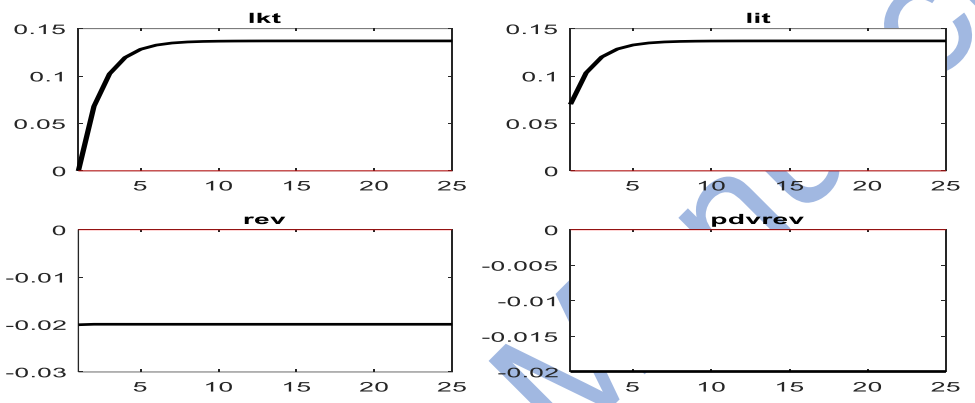

Figure 2 - The effects of the permanent allowances in investments on key variables -partial
Source: Research findings

4.2.2 The general equilibrium (sticky prices and wages)

4.2.2.1 The effects of accelerated depreciation shock

Figure 3 outlines the effects of excluding the amount of accelerated depreciation, calculated by a historical deduction method, from the taxable income. As it can clearly be seen, the responses of the investment and capital in case of sticky wages is enormous and touch at least 0.07 percent. The lasting of this reaction is more similar to temporary tax allowance and takes 5 periods after a sharp stimulation. The substantial efficacy is recorded on the government revenue and its future index, the amount of influence could be interpreted desirable in comparison to the other kinds of provoking methods. This reaction implies that the accelerated depreciation could be regarded as an appropriate method in dealing with the investment intriguing challenge.

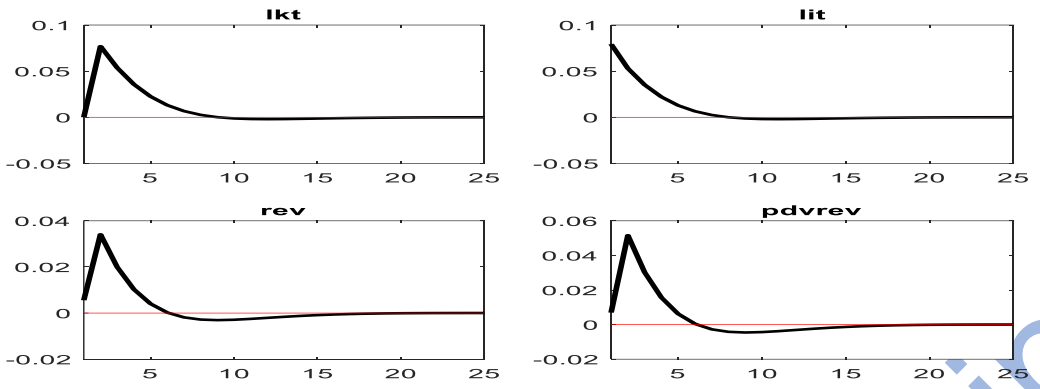

Figure 3- The effects of an accelerated depreciation on the key variables

Source: Research findings

4.2.2.2 The effects of the temporary tax allowances shock

Under the assumption of simultaneous stickiness in the wages and prices some clear changes in the model would be implemented. The first one is introducing different equations for the labor supply (equation number 20) and total supply of economy or the Philips curve (equation number 30). These equations, respectively, show the rigidity in wages and prices. The second is the possibility of evaluation of some new endogenous variables' behavior, such as consumption and output.

In theory, the sticky prices enforce firms to implement their commitment in providing goods and services, and this enforcement would be an immediate reason for them to be concern about their future profit. Because, an increase in prices cause a reflation in marginal costs and reduces the profit. One way to handle this challenge would be an intensification in the capital stock of the firm. As figure 4 sketches the reactions of the capital (ikt) and investment(lit) are positive but different in terms of the size. This implies that in the sticky case the effects of shocks, despite being transient, take long time to the capital to turn back at its initial value. The other important reason for different reaction of capital and investment is the distinctive definition of the depreciation rate which instead of calculating based on tax code is obtained from the model, endogenously.

The effect of tax allowance shock on the government revenues and cost-benefit index (pdvrev) is somehow different and takes time to become downward.

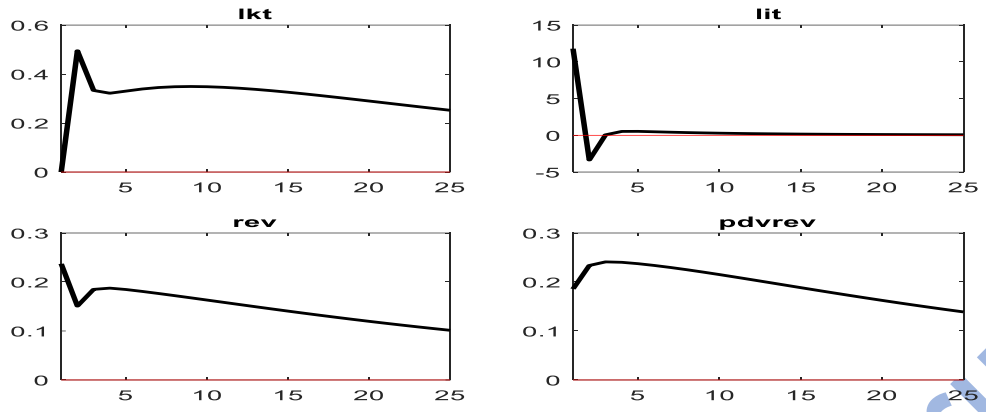

Figure 4–The effects of the temporary allowances in investments on key variables -partial equilibrium
Source: Research findings

4.2.2.3 The effects of permanent tax allowances shock

The influence of permanent tax incentives on capital and investment would be positive and significant in the long-run and shifts them to the new higher patch. As the figure 5 highlights, the reaction of capital is greater than investment in size and intensifies the level of production in a new line on lym panel. Another provoked variable is consumption which would positively be affected by incentive shocks. In comparison, however, the most sensitive variables to this kind of stirring are investment and capital accumulation which is in more harmony with theoretical discussion. In other words, other components of total demand, such as consumption, have to be incentivized by other kinds of suitable policy instruments.

In terms of the budget situation, despite fluctuations, it seems that tax allowances are expected to be compensated by new income generations for government and there is no room for serious concern about fiscal unsustainability in the stickiness condition of the economy.

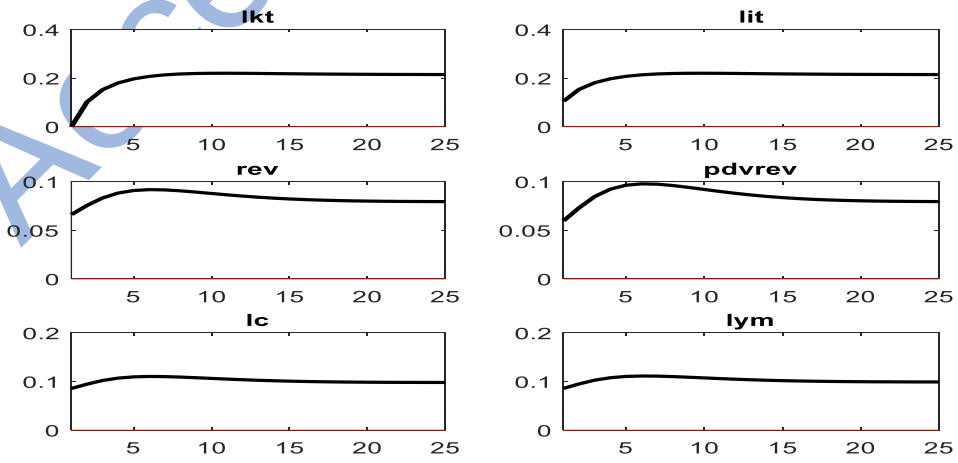

Figure 5- The effects of permanent allowances in investments on key variables -partial equilibrium
Source: Research findings

4.2.2.4 The effects of tax rate drop

One of the other types of the tax incentives is the plunge of tax rates to inspire economy towards more expanding. It is worth noting that the assessing of this issue is imperative due to providing possibility of a comparison among quite a broad range of tax incentives.

It is obvious from figure 6 that after a standard deviation of negative shock to the tax rate, the capital (lkt) and investment (lit) commenced to react a negligible volume in size. In contrast to the other incentives this kind of galvenizing method seems to be more ineffecint based on tax revenue forgone and cost-benefit indices. The responses of consumption and production are, also, smmaterring.

The important point in this regard is that the tax slump is not able to generate more new revenue to recover forgone revenue in the future. It means that the tax rate reduction will not be able to generate new investments and this, in turn, creates no new tax revenues for the government.

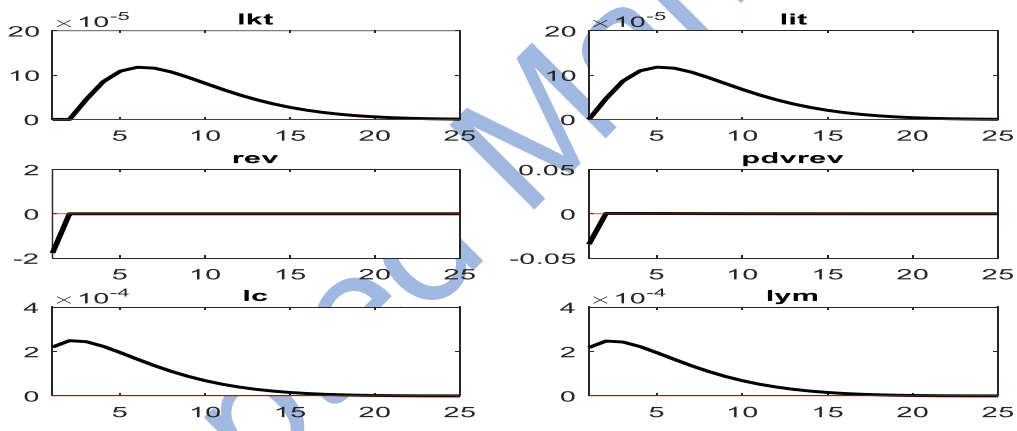

Figure 6 – the permanent effects of tax rate reduction
Source: Research findings

4.3 A robustbess check

In order to be more assured about the beneficial effects of some tax incentives on the whole investment, we appraised the effects of positive oil-revenue shocks on the behavior of the investment. As highlighted on the figure 7, In comparison to the effects of tax incentives, in spite of its remarkable positive effects on private investment, the oil-revenue shocks show more vacillating behaviour on one hand and unmanagable situation of international energy markets on the other. Therefore, the most certain and suitable way of policy making would be a controlabe fiscal policy to persuade the economy. In other words, relying on the sustainable tax policies would be desirable than hinging on oil-revenue-based policies.

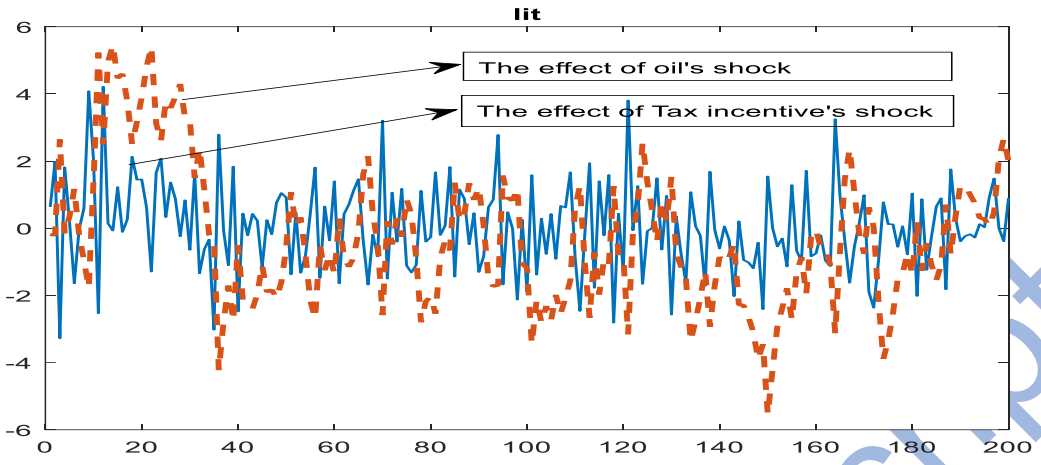

Figure 7- a comparison between oil revenues and tax incentive shocks on investmnet
Source: Research findings

5. Conclusion and policy implications

In light of elaborated assessment, the following key points can be drawn;
1)There was enough support for the conclusion that in case of flexible prices and wage index and grounded on the assumption of the partial equilibrium, the tax incentive policy, affecting positively capital accumulation and investment through capital cost plummet, would be root cause of the budget deficit of the government. In other words, ongoing tax incentive implementation would be an underlying reason of unsustainable fiscal policy. In this case, it would be better for the government to choose sustainable fiscal policy rather than investment provoking.

2) Moving on towards general equilibrium in result of adding other sectors of the economy to the model and omitting the effects of prices change, the positive effects of temporary tax allowances would be the contributing factor of capital and investment longer term surge (in comparison to the partial equilibrium case). In general equilibrium, the upswing of inflation will be hindered, and in its result the nominal interest rate starts to be dwindled and due to the dependency of investment on interest rate it incepts to escalation. The other point is that by obviating the inflation effect from economy the budget indices elucidate positive reaction and become under control. It implies that the inflation soaring triggers off more budget deficit and fiscal policy unsustainability in case of unmanageable situation.

3) Among well-known tax incentives, the precipitous tax drop is the most prevalent policy. The literature shows no concordance with the effectiveness of this kind of policy making. (For instance, the findings of Brandstette & Jacob, 2013). However, our research appears to validate the view that under the general equilibrium analysis, the investment and capital accumulation's reactions, though would be smattering but positive. It is supposed that, one primary cause of negligible reaction is different responses of all heterogenous firms to this policy. On the other hand, the reaction of public finance variables, being predictable, was in the form of a marked budget deficit.

4) Grounded on the sticky wages' assumption, employing accelerated depreciation instrument as a tax incentive, in terms of investment and capital's reaction is comparable to tax allowance effect but its size is larger. This greater effect springs from the stickiness of wages for at least one period. The positive aspect of using accelerated depreciation lies in its effect on the government budget. Since the budget takes no efficacy from this instrument, it seems that, in case of tight budget space, this tool can get a priority to be implemented.

5) In case of simultaneous rigidity in prices and wages, the effectiveness of positive shocks of tax allowances would be remarkable compared to just wage sticky. Because, the presence of fixed contracts and firm's commitment to provide goods and services at previous prices, and roughly constant interest rates, bring about the key variables, i.e., investment and capital accumulation, find sufficient opportunity to ascend. This occurrence stems from the indication of the theoretical point that the firm will continue to invest until the point that the marginal return of the investment is not greater than its marginal opportunity cost.

6) Comparing advantages of different kind of incentives leads us to the point that manipulating tax rate is inefficient than using other incentives such as accelerated depreciation or tax allowances. As a policy recommendation, this kind of incentive is not an appropriate instrument to encourage the economy in the normal situation. It might be used, however, as a last resort in severe recessions.

7) The effects of temporary and permanent tax incentive policies are not analogous. Compared to the permanent policies, the transient ones have larger and destabilizing impact. This ramification hints to the point that after intriguing the economy the policy should be stopped to preclude its negative dimension.

8) The reactions of investment and capital to the tax incentives in the general equilibrium are considerable in comparison with partial equilibrium. These responses are met even without presence of the wage or prices stickiness.

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Appendix

A.1 Solution

The most crucial variables which this study aims to evaluate the effects of tax incentives on their behavior can be obtained through taking first-order-conditions. By maximizing the utility function of household subject to constraints, we obtain intertemporal Euler equation (for C_t and C_{t+1}), labor and capital supply, respectively, as follows;

$$\frac{1}{\beta C_t^{\sigma} P_t} = \beta E_t \left[\frac{R_t^a}{C_{t+1}^{\sigma} P_{t+1}}\right] \quad (19)$$

$$W_t^i = \frac{\sum_{k=0}^{\infty} \gamma^k E_t\left[\left((\beta^k MU_{t+k}/P_{t+k})/(MU_t/P_t)\right)\left(L_{t+k}^i\right)^s \left(C_{t+k}^i\right)^{\sigma} \psi L_{t+k}\right]}{\sum_{k=0}^{\infty} \gamma^k E_t\left[\left((\beta^k MU_{t+k}/P_{t+k})/(MU_t/P_t)\right)((1-\tau_t^l/P_t)(\psi-1)L_{t+k}\right]} \quad (20)$$

$$E_t\left[\frac{R_{t+1}^k(1-\tau_{t+1}^k)}{P_{t+1}}\right] = E_t\left[\frac{R_t^a}{inf_{t+1}}\left(1-\tau_t^k inc_t - PDV_t^{\delta}(1-inc_t)\right.\right.$$
$$\left.\left.-E_t\left[(1-\delta)\left(1-\tau_{t+1}^k inc_{t+1} - PDV_{t+1}^{\delta}(1-inc_{t+1})\right)\right]\right. \quad (21)$$

Using equation (3) the variable R_t^a is obtained. The variable PDV_t^{δ} in equation 21 is the discounted present value of future depreciation which the family can deduct from whole tax liability. When depreciation allowances are equal to the real depreciation of economy the equation can be specified as follows;

$$PDV_t^{\delta} = E_t\left\{\sum_{v=1}^{\infty} \frac{\beta^v MU_{t+v}/P_{t+v}}{MU_t/P_t} \delta(1-\delta)^{v-1}\tau_{t+v}^k\right\} \quad (22)$$

The reason behind using stochastic discount factor is existing the future flow of revenues.

A.1.1 Log-linearization

With linearization of variables around their steady state values the linear version of the model would be available. The log-linear difference equation for the capital covering installing costs would be;

$$\mathrm{lr}_{t+1} = \left[\frac{\tau_*^k}{1-\tau_*^k}\right] lt_{t+1}^k - \left[\frac{1}{1-\frac{\overline{inf}}{r_*^a}(1-\delta)}\right]\left[\frac{pdv_*^\delta}{1-pdv_*^\delta}\right]\left[pdv_t^\delta - \frac{\overline{inf}}{r_*^a}(1-\delta)pdv_{t+1}^\delta\right]$$
$$-\left[\frac{1}{1-\frac{\overline{inf}}{r_*^a}(1-\delta)}\right]\left[\frac{\tau_*^k - pdv_*^\delta}{1-pdv_*^\delta}\right]\left[inc_t - \frac{\overline{inf}}{r_*^a}(1-\delta)inc_{t+1}\right]$$
$$+\left[\frac{1}{1-\frac{\overline{inf}}{r_*^a}(1-\delta)}\right] lr_t^a + \left[\frac{1}{1-\frac{\overline{inf}}{r_*^a}(1-\delta)}\right][lB_t - 1 - \frac{\overline{inf}}{r_*^a}(1-\delta)lB_{t+1}] \quad (23)$$

Where;

$$B_t = -\vartheta_t^{\Delta k} - \frac{PDV_*^\delta}{1-PDV_*^\delta}.pdv_t^\delta - \frac{\tau_*^k - PDV_*^\delta}{1-PDV_*^\delta}.inc_T \quad (24)$$

The star (*) symbol in the equations is the steady state value of the variable. The other remaining key log-linear equations for the model would be;

$$1 + \frac{\overline{inf}}{r_*^a}(1-\delta)li_t = li_{t-1} + \frac{\overline{inf}}{r_*^a} li_{t+1} + [\tfrac{1}{\omega^{\Delta k}}]lB_t \quad (25)$$

$$pdv_t^\delta = \tfrac{1}{r_*^f}(1-\delta)pdv_{t+1}^\delta + \tfrac{1}{r_*^f}(1-\delta)lr_{t+1}^a - lr_t^a \quad (26)$$

$$li_t = \left(\tfrac{1}{\delta}\right) lk_t - (\tfrac{1-\delta}{\delta})lk_{t-1} \quad (27)$$

$$lc_t = \tfrac{1}{\delta} lr_t^a - lc_{t+1} \quad (28)$$

$$lr_t^f = [\tfrac{r_*(1-\tau_*^l)}{r_* - \tau_*^l(r_*-1)}] lr_t - [\tfrac{\tau_*^l(r_*-1)}{r_* - \tau_*^l(r_*-1)}] lf_{t+1}^l \quad (29)$$

$$\Delta p_t = \beta E_t \Delta p_{t+1} + \tfrac{(1-\eta)(1-\eta\beta)}{\eta}.mc_t : \text{Philips curve} \quad (30)$$

$$\mathrm{lw}_t = -[\tfrac{\alpha}{1-\alpha}] lr_t \quad (31)$$

$$lk_t = \left[\tfrac{\theta-1}{\theta}\right] \bar{ly} - lr_t \quad (32)$$

$$\bar{ly} = \tfrac{\bar{c}}{y} lc_t + \tfrac{\bar{\imath}}{y} li_t \quad (33)$$

$$\left[\tfrac{\theta-1}{\theta}\right] \bar{ly} = lk_{t-1} + (1-\propto)ll \quad (34)$$

$$\mathrm{rev}_t = \left[\frac{\bar{y}\tau_*^l}{rev_*}\right][l\tau_t^l + \bar{ly}] + \left[\frac{\tau_*^k r_* k_*}{rev_*}\right] l\tau_t^k - \left[\frac{\tau_*^l r_* k_*}{rev_*}\right] l\tau_t^l - \left[\frac{\tau_*^k i_*}{rev_*}\right] inc_t - \left[\frac{\tau_*^k incb_*}{rev_*}\right][l\tau_t^k + incb_{t-1}]$$

(35)

$$\text{pdvrev}_t = \left[1 - \frac{\overline{inf}}{r_*^a}\right] rev_t - \frac{\overline{inf}}{r_*^a} lr_t^f + \frac{\overline{inf}}{r_*^a} lpdvrev_{t+1}$$

(36)

$$incb_t = \left[\frac{\overline{inf} - (1-\delta)}{\overline{inf}}\right] i_* li_t - \left[\frac{\overline{inf} - (1-\delta)}{\overline{inf}}\right] i_* inc_t + \left[\frac{(1-\delta)}{\overline{inf}}\right] incb_{t-1}$$

(37)

A closer look at the above equations indicates that the tax policies including taxation and tax incentives affect variables through the two main channels: first, through the growth of consumption and capital cost which are functions of the after-tax nominal interest rate and the second, through depreciation allowances which are valued based on their historical values which itself discounts by the nominal interest rate.