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Exogenous Oil Shocks, Fiscal Policy and Sector Reallocations in Oil Producing Countries

By **Alessandro Cologni**, Edison Trading, Edison S.p.A, Milan, Italy

Matteo Manera, Department of Statistics, University of Milan-Bicocca, and Fondazione Eni Enrico Mattei, Milan, Italy

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Summary

Previous literature has suggested that different mechanisms of transmission of exogenous oil shocks are responsible for the negative effects on the economic performances of oil exporting countries. This paper aims at providing further evidence on the role of sectoral reallocation between private and public sectors in explaining the impact of shocks to oil revenues on the economic growth rates of major oil producing countries (namely the GCC - Gulf Corporation Council - countries). The effects of oil shocks and expansionary fiscal policy on the business cycle of oil producing countries are examined. The possibility to distinguish between various components of public sector spending policy (that is, purchases of consumption goods, investments in productive activities and compensation for public employees) is, in particular, allowed for. A real business cycle (RBC) model is calibrated to fit the data on an "average" oil producing country. Results from the simulation of the theoretical model suggest that the possibility that crowding-out effects of public over private investments can explain a large fraction of the negative effects of shocks to oil revenues on the private sector of the economy. In addition, since the growth in size of the public sector is unable to compensate for the reduction in size of the private sector, an increase in oil revenues has the effect to decrease total output. An expansionary fiscal policy is argued to have significant positive effects on private investments, employment and overall production. On the contrary, a shock to government consumption expenditure impacts negatively the level of public investment. As employment in the public sector increases significantly, public output responds positively to a shock in government consumption expenditure. Finally, an instantaneous negative effect on total investments and on the stock of capital in the economy is predicted. However, driven by the increase of the number of employees in the economy, total output expands.

Keywords: Oil Shocks, Dutch Disease, Resource Curse and Real Business Cycle Modelling

JEL Classification: C61, E22, E62, Q48

Address for correspondence:

Matteo Manera
Fondazione Eni Enrico Mattei
Corso Magenta 63
20123 Milan
Italy
E-mail: matteo.manera@unimib.it

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Alessandro Cologni[a], Matteo Manera[b,c,*]

[a]*Edison Trading, Edison S.p.A., Milan, Italy*
[b]*Department of Statistics, University of Milan-Bicocca, Milan, Italy*
[c]*FEEM, Fondazione Eni Enrico Mattei, Milan, Italy*

Abstract

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This paper aims at providing further evidence on the role of sectoral reallocation between private and public sectors in explaining the impact of shocks to oil revenues on the economic growth rates of major oil producing countries (namely the GCC - Gulf Corporation Council - countries). The effects of oil shocks and expansionary fiscal policy on the business cycle of oil producing countries are examined. The possibility to distinguishing between various components of public sector spending policy (that is, purchases of consumption goods, investments in productive activities and compensation for public employees) is, in particular, allowed for.
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*Corresponding author
Email addresses: alessandro.cologni@edison.it (Alessandro Cologni), matteo.manera@unimib.it (Matteo Manera)

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1. Introduction and literature review

There is a large body of research which tries to assess how oil shocks influence the business cycle of oil producing countries. According to many empirical papers, countries which are endowed with relevant natural resources are characterized by lower economic growth rates with respect to countries with few natural resources. Important studies on the failures of resource-led development include, for instance, Gelb and Associates [1], Sachs and Warner [2], Sachs and Warner [3], Sala-i Martin and Subramanian [4], Gylfason [5]. In particular, Sachs and Warner [3] find a strong inverse relationship between the log of the export contribution to growth during the period 1970-1990 and the log of natural resource abundance in 1970. Sachs and Warner [2] briefly survey the Dutch disease explanation for the natural resource curse. According to this mechanism, export windfalls have adverse effects on the real exchange rate of these countries. This, in turn, renders most other exports uncompetitive. Thus a rapid and, often distorted, growth of the non-tradeable sector may occur. In turn, the industrialization process of the country, as well as the traditional economic sectors (i.e. agriculture), are negatively affected. As noted by Sala-i Martin and Subramanian [4], countries that depend heavily on the export of natural resources tend to suffer from a variety of problems, including authoritarian governance, antistate protests and/or civil wars, high corruption levels, high poverty rates, etc.[1, 2]

In this work, we aim at studying a different, but by no means less important, mechanism of transmission of oil shocks to the overall economy of oil producing countries, which is represented by the reallocation effects associated with oil shocks and the fiscal policy implemented by the government.

Starting from the pioneristic works of Bruno [7], Forsyth and Kay [8], Corden and Neary [9], the effects of domestic resource discoveries on tradeable and non-tradeable sectors of open economies are assessed by many theoretical and empirical studies. According to this branch of literature, oil discover-

[1]For a review of the literature on the effects of oil endowments on oil producing countries see Alexeev and Conrad [6].

[2]Other authors find a positive effect of a large endowment of oil and other mineral resources on long-term economic growth. According to Alexeev and Conrad [6], although large endowments of oil and other mineral resources do not affect significantly political institutions, positive effects on long-term economic growth may nevertheless occur.

ies prompts huge booms in investments, especially in the non-traded goods sectors of the economy. In contrast, investments and profits in the traded sectors are squeezed by the oil boom. As the non-traded goods sectors expand, the traded goods sectors of these countries tend to shrink.
On the other hand, Cuddington [10] emphasises the issues related to the effects of the spending policy implemented by the public sector. According to this author, poor management of oil wealth and, in particular, inefficient spending by the public sector induces significant imbalances in the internal market.
Hausmann and Rigobon [11] argue that distorted allocations of spending over time by the public sector are enhanced in the presence of common-pool problems or uncertainty over property rights over the resource income. This fact, in turn, may further enhance low economic performances. Fasano-Filho and Iqbal [12], in an analysis of how to improve economic performance of the Gulf Council Countries, suggest to reallocate oil wealth in such a way to improve economic incentives directed at boosting the growth of the private sector.
Similarly, studies by Barnett and Ossowski [13], Eifert et al. [14], Leigh and Olters [15], among others, are interested in the operational aspects of fiscal policy in oil producing countries. These works offer indications on fiscal policy adjustments in order to reduce the negative effects on sustainable economic growth arising from high volatile and uncertain flows of oil revenues from abroad.
The reallocation effects of booms in resource revenues affect also oil importing countries. Several papers argue that oil price shocks often require an unusual amount of labour to be reallocated across industries of developed economies, thereby increasing the unemployment rate in those periods.
Lilien [16] contends that reallocative shocks significantly affect aggregate unemployment by increasing the amount of labour reallocation required. According to Loungani [17], macroeconomic models typically assign primary importance to aggregate demand shocks in the determination of the unemployment rate. This reflects the belief that shocks to the composition of demand merely lead to a reallocation of labour resources across industries. This evidence finds empirical support in Hamilton [18], who shows that oil prices Granger-cause unemployment.
Davis and Haltiwanger H. [19] argue that factor specialization and reallocation frictions led to reduced output and employment in the US economy in the wake of the first oil price shock (1973). During that experience, sectors

like the car industry were particularly hit, as their actual features of factor inputs did not closely match the desired characteristics.[3]

In Lee and Ni [20] Vector Autoregression models are used to investigate how different sectors of the US economy are affected by oil shocks. Results of impulse response functions indicate that oil price increases mainly reduce supply for high energy-intensive industries. On the other hand, oil price shocks affect many other industries (such as the car industry) by reducing demand for their products. According to Keane and Prasad [21], oil prices shocks are associated with variations in employment shares and relative wages across industries. Results suggest that, while real wages declines for all workers, wages for skilled workers increase.

This paper aims at providing further evidence on the effects of exogenous oil shocks on the macroeconomic performances of oil exporting countries. It does so by means of a simple theoretical framework based on the real business cycle (RBC) modelling of macroeconomic activity in oil producing countries. The questions we would like to answer can be summarized as follows. How are oil shocks likely to affect the economic activity of oil exporting countries? More specifically, what are the effects of oil shocks and expansionary fiscal policy on consumption, investments and labour markets? Do oil shocks increase the role of the public sector in the economy[4]? How important are changes in the allocation of production inputs across sectors in determining the economic consequences to an expansion of government consumption expenditure?[5]

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[3]For instance, the auto industry and the network of dealership were specialized, respectively, in the production and sale of large cars. Similarly, skills of workers in the auto industry and research and design activities were directed at producing and engineering large cars. However, the demand of this type of cars dropped as oil prices increased after the oil shocks.

[4]In the present paper, the words *government* and *public sector* are used interchangeably.

[5]Shifts in demand across sectors induced by changes in public spending is well documented in literature. For instance, Ramey and Shapiro [22] examine the effects of changes in public spending on the reallocation of production factor in a two-sector dynamic general equilibrium model. Under the assumption that changes in public spending are ofthen sector-specific, shifts in the allocation of factors across industries can lead to declines in employment and changes in the wages paid across sectors.

This paper extends the previous literature on the macroeconomic effects of exogenous oil shocks on the economic stance of oil exporting countries in various directions. The hypothesis that oil price shocks drive large aggregate reallocation of production factor is investigated by several previous studies. However, earlier work lacks the sectoral detail on job creation and destruction that we examine. In other words, our theory can be view as an attempt to describe the Dutch disease that often affects oil producing nations by means of a RBC modelling.

In addition, differently from this literature, our analysis focuses on the sectoral reallocation adjustment process that follows a negative wealth effect induced by an exogenous oil shock. In particular, a two-sector economy in which the public sector role is separately considered from the role of private firms is considered.

Many assumptions of our analysis are similar to those considered in the work on the cyclical effects of fiscal policy when investment in public capital is allowed for (see, *inter alia*, Finn [23] and Lansing [24]). Nevertheless, the focus is quite different.[6] We concentrate on the mechanism of transmission of exogenous oil shocks on producing countries, whereas Finn [23] considers the different effects of government fiscal policy on both private and public sectors for the US economy.

Finally, this paper derives some analytical conditions of fiscal policy under which the negative economic effects of shocks to oil revenues and government consumption expenditure are reduced. Implications of fiscal policies aimed at reducing the so-called natural resource curse are, hence, presented.

We focus our attention on annual data for major oil producing countries. In particular, economic data referring to the Gulf Cooperating Council (GCC) countries of Bahrain, Kuwait, Oman, Qatar, the United Arab Emirates and the Kingdom of Saudi Arabia are examined. One of the most important features of this organization is that its member countries own the largest world's proven oil reserves. According to British Petroleum data referring to the end of 2009, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates possess approximately 37.2% of world's oil proven reserves. Saudi Arabia,

[6] Several assumptions of the theoretical model also differ significantly with respect to this paper. The main differences involves the source of exogenous growth, the functional form taken by government budget constraint, the role of the public sector in the economy as far as productive activities are concerned.

in particular, is the world's largest oil producer with approximately 19.8% of total world's oil reserves (or 265 billion barrels). Despite diversification efforts in government expenditure growth, particularly in the past few years, in GCC countries governments still account for about 40 percent of overall aggregate demand, one of the highest share in the world.[7]

The model is calibrated to an "average" oil exporting country in order to describe the effects of government activity in affecting its economic performances. Its rough quantitative consistency with second moments of the data is, then, examined. In order to examine the effects of exogenous shocks on our simplified economy, the effects of one positive percent shock to oil revenues and government consumption expenditure on relevant variables are, hence, examined and discussed.

One of the main results we obtain is that oil shocks cause a reallocation of economic activities between the private and public sectors of the economy. In particular, higher oil revenues seems to cause a crowding-out effects on both private consumption and investment.[8]

In fact, higher investments by the public sector are associated with reductions in the process of accumulation of capital by the private sector of the country. Although the estimated impact on demand for labour supply in the public sector is positive, supply for private labour decreases. As the effect on the private sector outpaces that on the private sector, the overall unemployment rate of the economy increases, nevertheless, increases. All in all, while the role of the public sector in the economy expands, the importance of the private sector lessens out. However, since this latter effect tends to be larger with respect to the former, the impact of exogenous oil shocks on total output is argued to be negative.

A shock to government consumption expenditure has as its main effect to increase economy's wealth. In fact, despite the fact that more of the economy's goods are consumed by the government, private investments, employment

[7]Source: our elaborations on World Bank's data (World Development Indicators, 2010) and Penn's World Tables data.

[8]According to Aschauer [25], the increase of the stock of public capital causes positive effects on both the national investment rate and the return to private capital. If follows that higher investments by the public sector have a direct impact on the process of accumulation of private capital.

and overall production respond positively to an expansionary fiscal policy. In addition, a shock to government consumption impacts negatively the level of public investments and the level of public capital. However, as employment in the public sector increases significantly in response to a shock in government expenditure, public output expands. Finally, our model predicts an instantaneous negative effect on total investments and on the stock of capital in the economy. Nevertheless, driven by an expansion of the number of employees in the economy, total output increases as a consequence of expansionary fiscal policy.
The paper is organized as follows. Section 2 presents the theoretical model employed in order to examine the macroeconomic effects of oil shocks in oil exporting countries. In particular, Section 2.1 outlines the assumptions of the framework employed in our analysis, while Section 2.2 considers the set-up of our theoretical model. Section 3 investigates the consequences of disturbances to oil revenues to key macroeconomic variables. Sections 3.1 and 3.2 describe the framework implemented in order to calibrate model and the main results referring to the simulation of the RBC model. Section 3.3 outlines the main results of one percent oil and government consumption expenditure shock on relevant variables of both public and private sectors. Section 3.4 discusses how results varies if different assumptions on key parameters and steady-state ratios are made. Section 4 concludes.

2. The theoretical model

2.1. Assumptions

The effects of exogenous oil shocks on the economic performance of oil exporting countries are studied by means of a simple neoclassical growth model where preferences, technology and resource constraints for both private and public agents are considered together with rules governing public finance. Households, firms and the government interact in a variety of ways within a perfectly competitive market structure.

Households

There is a representative household which aims at maximizing a discounted sum of period utilities over an infinite planning horizon. The household has preferences over sequences of consumption and leisure and maximizes its expected lifetime utility. The lifetime utiliy function is, in particular, given by:

$$E_0 \sum_{t=0}^{\infty} \beta^t u_t \left(C_t,\ L_t,\ G_t\right) \tag{1}$$

where E_0 represents the expected value operator. C_t and G_t represent, respectively, private and public consumption, while L_t denotes leisure.
According to this equation, future momentary utilities, u_t, are discounted using the subjective discount factor β, $\beta \in (0,\ 1)$.
The fully parameterized momentary utility function employed in this study is given by:

$$u_t \left(C_t,\ G_t,\ L_t\right) = \frac{\left(C_t^{\psi} G_t^{1-\psi}\right)^{1-\sigma} L_t^{1-\vartheta}}{1-\sigma} \tag{2}$$

where σ and ϑ denote preference parameters. In particular, $\sigma > 1$ is the inverse of intertemporal elasticity of substitution in consumption whereas, ψ is a parameter denoting the degree of substitutability between private and public consumption expenditure. According to this period utility function, government consumption expenditure provides utility for the household, as it represents a substitute for private consumption.[9] It can be easily verified that utility depends positively on consumption services and leisure. Furthermore, it can be observed that $v_L < 0$ and $v_{LL} > 0$[10] where $v(L_t) = L_t^{1-\vartheta}$, $\vartheta > 0$. In other words, $v(.)$ is a decreasing and convex function of leisure. Assuming constant leisure, these features of the momentary utility function are compatible with steady-state growth in consumption. Thus, the specification of the period utility function we employ ensures positive first and negative second derivatives of the utility function with respect to consumption levels, i.e. $u_C > 0$, $u_{CC} < 0$, $u_G > 0$, $u_{GG} < 0$, that is utility is an increasing and concave function in both private and public consumption.
The household has a time endowment which is normalized to one. The sum of time devoted to work and leisure cannot exceed its endowment of time. Consequently, labour supply N_t and leisure L_t are related through the following

[9] This assumption follows Finn [23].

[10] v_X and v_{XX} denote, respectively, first and negative second derivatives of function $v(X)$ with respect to X.

time constraint:[11]

$$L_t + N_t = 1 \tag{3}$$

In addition, in each period the representative household faces the following within-period budget constraing

$$W_t N_t + R_t K_t^P + \Pi_t \geq C_t + I_t^P \tag{4}$$

where W_t is the real wage rate, R_t is the real rental rate on capital, I_t^P is gross private investment and Π_t the firm's profit. According to equation (4) total income earned by the household has to be greater (or, at least, equal) to its total spending.

The household owns a stock of capital (K_t^P) which is rented to the representative firm each period. The rule governing the process of capital accumulation is given by:

$$K_{t+1}^P = \left(1 - \delta^P\right) K_t^P + I_t^P \tag{5}$$

where $\delta^P \in [0,\ 1]$ is the rate of depreciation of private capital. K_0 is assumed to be constant.

The household chooses sequences $\{C_t,\ N_t,\ K_{t+1}\}_{t=0}^{\infty}$ to maximize the intertemporal utility function (1) subject to the flow budget constraint (4) and to equation (3). Let us set the Lagrangian for the household maximization problem:

$$L_H = E_0 \sum_{t=0}^{\infty} \left\{ u_t \left(C_t,\ G_t,\ N_t\right) + \lambda_t \left\{ W_t N_t + R_t K_t^P - C_t - \left[K_{t+1}^P - \left(1 - \delta^P\right) K_t^P\right] \right\} \right\}$$

where λ_t is the Lagrange multiplier associated to equation (4).

The first-order conditions for an interior solution to the household's problem are represented by:

$$\frac{\partial L_H}{\partial C_t} : \lambda_t = u_C \left(C_t,\ G_t,\ N_t\right) \tag{6}$$

[11]For simplicity, we assume that the time-endowment constraint of the household always binds with equality.

$$\frac{\partial L_H}{\partial N_t} : \lambda_t w_t = -u_L \left(C_t,\ G_t,\ N_t\right) \tag{7}$$

$$\frac{\partial L_H}{\partial K_{t+1}^P} : \lambda_t = \beta E_t \lambda_{t+1} \left[\left(R_{t+1} - \delta^P\right) + 1\right] \tag{8}$$

$$\frac{\partial L_H}{\partial \lambda} : K_{t+1}^P = Y^d - C_t + \left(1 - \delta^P\right) K_t^P = 0 \tag{9}$$

Other conditions to consider are given by equations (3), (5) and by the transversality condition:

$$lim_{t \to \infty} \lambda_t K_{t+1}^P = 0. \tag{10}$$

Firms

Households own a single firm that produced (private) output Y_t^P according to the following technology:

$$Y_t^P = f_t^P(N_t^P,\ K_t^P) = A_t \left(K_t^P\right)^\theta \left(N_t^P\right)^{1-\theta} \quad \theta \in (0, 1) \tag{11}$$

where $\theta \in (0,\ 1)$. With this technology the firm employ two factors of production: the per capita stock of private capital, K_t^P, and the per capita labour supply, N_t^P. The Cobb-Douglas production function (11) is characterized by constant returns to scale with respect to N^P and K^P.
Taking market prices as given, the firm maximizes profit Π_t from the production of goods:

$$\Pi_t = Y_t^P - W_t N_t^P - R_t K_t^P \tag{12}$$

The firm's decision problem can, hence, be summarized as:

$$max_{K_t^P,\ N_t^P} A_t \left(K_t^P\right)^\theta \left(N_t^P\right)^{1-\theta} - W_t N_t^P - R_t K_t^P$$

Behaviour aimed at profit maximization implies that the marginal product of each factor has to be set equal to its user cost. Hence, equilibrium conditions for the firm are represented by:[12,13]

$$\frac{\partial Y_t^P}{\partial N_t^P} : (1-\theta)\left(\frac{K_t^P}{N_t^P}\right)^{\theta} = W_t \tag{13}$$

$$\frac{\partial Y_t^P}{\partial K_t^P} : \theta\left(\frac{K_t^P}{N_t^P}\right)^{1-\theta} = R_t \tag{14}$$

or, if we consider equation (11):[14]

$$W_t = (1-\theta)\left(\frac{Y_t^P}{N_t^P}\right)$$

$$R_t = \theta\left(\frac{Y_t^P}{K_t^P}\right)$$

The government

Finally, there is a government which hires labour from households, N_t^G and invests a fraction of its revenues in order to produce government output. In addition, it purchases consumption goods from the market. In other words, intervention of fiscal policy in the economic system is assumed to take several forms: purchases of consumption goods, investments in productive activities and compensation for public employees.

The government has only one sources of revenues: it owns a flow endowment of a natural resource commodity (in our case, oil), whose value in each period

[12]By simple substitution of equations (13) and (14) into equation (12) we obtain that total profits are equal to zero.

[13]Since, in this paper, we focus on the effects on businecss cycle movements of relevant variables of exogenous oil shocks we abstract from technological progress. In that follows, A_t is, therefore, constrainted to be equal to one.

[14]The equations which result from the optimization problem of households and firms can be summarized by the following "implementability constraint": $E_0 \sum_{t=0} \beta^t \left\{u_C\left(C_t,\ G_t,\ N_t\right)C_t + u_N\left(C_t,\ G_t,\ N_t\right)N_t\right\} - u_C(C_0,\ G_0,\ N_0)R_0K_0^P = 0$ where $R_0 = \theta\frac{Y_0^P}{K_0^P} - \delta^P + 1$.

t is given by Z_t.[15]
Public output (Y_t^G) is produced according to the following production function:

$$Y_t^G = f_t^G(N_t^G,\ K_t^G) = A_t \left(K_t^G\right)^{\gamma} \left(N_t^G\right)^{1-\gamma} \quad \gamma \in (0,1) \tag{15}$$

where N_t^G and K_G^t are the stock of labour and capital employed by the government for production purposes and A_t denotes total production augmenting technological progress. In equation (15), constant returns to scale over (public) capital and labour are assumed.[16]
Government's investment increases the capital stock K^G subject to the following law of motion:

$$K_{t+1}^G = \left(1 - \delta^G\right) K_t^G + I_t^G \tag{16}$$

where I_t^G denotes (exogenous) gross public investment and $\delta^G \in [0,\ 1]$ is the rate of depreciation of public capital.[17]
In each period, the government faces the following budget constraint:

$$Z_t = G_t + I_t^G + W_t N_t^G \tag{17}$$

where Z_t denotes the flow of exogenous oil revenues the government obtains from abroad, respectively.

[15]Although this seems to be a strong assumption, we need to remember that, for GCC countries, oil accounts for a very high percentage of government's revenues and exports earnings. In addition, these countries are almost tax-free economies (see Razzak and Labas [26]). According to World Bank's data (World Development Indicators, 2010), for these countries as a whole, in 2007 fuel exports accounted for approximately 55 percent of GDP and 83 percent of total merchandise exports.

[16]Since in our analysis we focus on innovation caused by shocks in exogenous oil revenues and government consumption expenditure we abstract from the effects of the technical progress on the trend growth in the economy. Therefore, A_t is assumed constant and equal to one.

[17]Please notice that, the private sector is not renting out capital to the government sector. On the contrary, here, K_t^G is exogenously supplied by the government. Consequently, the price of the capital does not alter its budget constraint (equation 17) (see Lansing [24] and Finn [23]).

According to equation (17), the total amount of resources used by the government for purchases of consumption goods, investments and compensation for public employees can not exceed total external revenues. The possibility to differentiate between government's purchases of consumption and investment goods enable us to assess the relative importance of the different mechanisms of transmission of the fiscal policy. In particular, we are able to distinguish between the utility effects which arise from government's purchases and the effects on sectoral reallocation of employment and investments determined by the productive decisions by the public sector .

Government's fiscal policy responds to the stance of world's economy summarized by changes in oil prices. Consequently, a quantitative analysis of the response of fiscal policy decisions (in particular, government investments and employment) to exogenous oil fluctuations has to be employed. Thus, we will be able to evaluate whether these components are positively or negatively related to the business cycle of oil producing countries.

The quantitative analysis considered in this paper necessarily requires the specification of the process followed by the exogenous variables Z_t and G_t. The stochastic processes for prices and production levels are combined into a single process which is described by the following formula:[18]

$$Z_t = (1 - \rho_Z)logZ + \rho_Z logZ_{t-1} + \epsilon_{Z,\ t} \tag{18}$$

where $\rho_Z < 1$ and $\epsilon_{Z,\ t}$ denotes shocks to Z_t and $\epsilon_{Z,\ t}$ is distributed according to a $N(0, \sigma^2_{\epsilon_Z})$ process. In other words, the variable Z_t evolves according to an AR(1) process (autoregressive process of order 1).

Similarly, we assume that government consumption expenditure evolves according to the following AR(1) process:

$$G_t = (1 - \rho_G)logG + \rho_G logG_{t-1} + \epsilon_{G,\ t} \tag{19}$$

here $\rho_G < 1$ and shocks to G_t ($\epsilon_{G,\ t}$) are distributed according to a $N(0, \sigma^2_{\epsilon_G})$ process.

Finally, by combining the government budget constraint (17) with the household budget constraint (4), the following economy-wide constraint is ob-

[18]This assumption is similar to that adopted by Smith and McCardle [27] which considered for oil revenues the following process: $dx(t) = \mu_x x(t)dt + \sigma_x x(t)dz_x(t)$ where $dz_x(t)$ are increments of a standard Brownian motion process.

tained:

$$C_t + I_t + G_t \leq Y_t \tag{20}$$

where $I_t = I_t^P + I_t^G$.[19]
According to equations (17) and (20), consumption and investments by private and public agents and compensation for public employees by the public sector completely absorb the economy's resources.[20]

2.2. The Ramsey equilibrium

The equilibrium of the economy is obtained when the representative firm and representative household solve their optimization problems, the public sector satisfies its budget constraint and all markets clear. The rational expectations equilibrium consists of the sequences of endogenous variables which satisfy the following set of first order equations and accounting identities:

$$W_t = \frac{\partial f^P(N_t^P,\ K_t^P)}{\partial N_t^P} = \frac{\partial f^G(N_t^G,\ K_t^G)}{\partial N_t^G} \tag{21}$$

$$R_t = \frac{\partial f^P(N_t^P,\ K_t^P)}{\partial K_t^P} \tag{22}$$

$$-\frac{\partial U(C_t,\ G_{,t}\ ,\ N_t)}{\partial N_t} = \frac{\partial U(C_t,\ G_{,t}\ ,\ N_t)}{\partial C_t} W_t \tag{23}$$

$$\frac{\partial U(C_t,\ G_{,t}\ ,\ N_t)}{\partial C_t} = \beta E_t \left[\frac{\partial U(C_{t+1},\ G_{t+1},\ N_{t+1})}{\partial C_{t+1}} \left(R_{t+1} + 1 - \delta^P \right) \right] \tag{24}$$

$$X_t \equiv X_t^P + X_t^G \tag{25}$$

[19] Substituting the profit maximization problem of the firms, $Y_t^P = W_t N_t^P + R_t K_t^P$ into equation 4 yields $Y_t^P + W_t N_t^G = C_t + I_t$ which when substituted into equation 20 implies that the resources are equal to the sum of Y_t^P and Z_t.

[20] In that follows the resource constraint (20) is used in place of the government budget constraint (17) since the two equations are not independent.

where $X_t = \{K_t,\ I_t,\ N_t,\ Y_t\}$.
Equations (21) and (22) give the outcome of the maximizing behaviour by firms. According to these expressions, equilibrium is guaranteed when the marginal productivities of labour and capital equals their marginal costs.
Equation (23) represents the household *intratemporal* efficiency condition governing its labour supply and investment. This equation tells us that the marginal rate of substitution between labour and consumption must be equal to the marginal product of labour. On the other hand, equation (24) establishes the *intertemporal* efficiency condition, that is the Euler equation first-order condition. At equilibrium, the marginal cost, in terms of utility, of investing in more capital should be equal to the expected marginal utility gain.
Finally, the set of equations (25) shows that capital, labour and output markets clear when the sum of private and public labour and production equals total supply.
Other conditions to be satisfied are given by the laws of motion for K^P and K^G (equations 5 and 16), production functions by the private and public sectors (equations 11 and 15), the government budget constraint (equation 17), the process representing the behavior of exogenous shocks (equations 18 and 19), and the economy-wide constraint (equation 20).

3. Solution of the model

3.1. Calibration

The model's cyclical implications are explorated by means of a quantitative analysis based on the solution of the theoretical economic model presented in Section 2. In this Section the calibration of the theoretical model is presented. According to the procedure proposed by Kydland and Prescott [28], values are to be assigned to the model's parameters and steady-state variables.[21]
Our main objective is to provide information on the effects of exogenous oil shocks on the economic performances of a number of oil producing countries.

[21] In steady-state, since no trend growth in exogenous variable is assumed, all variables take constant values. This implies the absence of uncertainty. In this representation of the model economy, variables tend to fluctuate around the values given by this path.

The values of model's parameters and steady-state variables are, hence, chosen to fit information on the Gulf Cooperating Council countries of Bahrain, Kuwait, Oman, Qatar, the United Arab Emirates and the Kingdom of Saudi Arabia. These countries share a set of important features. As all these economies are almost tax-free, they depend for an important fraction of their revenues on rents obtained by exporting oil (and, also, natural gas) to the developed economies. In other words, they are rent-economies that distribute resources in proportion to the hydrocarbon revenues they receive.
Data from widely recognized organizations and institutions (namely, U.S. Department of Energy - Energy Information Administration - World Bank - World Development Indicators, 2010 - United Nations - International Labour Organization - International Monetary Fund - International Financial Statistics, October 2010 - and University of Pennsylvania - Penn's World Tables) are employed at the purpose of calibrating the model to the economic performances of the GCC countries.[22]
According to Stockman and Tesar [29] we assign to the intertemporal elasticity of substitution of consumption (σ) a value equal to 2 whereas the rate of time preference (β) is set equal to 0.96. As our benchmark case, we introduce an imperfect degree of substitutability between private and public consumption expenditure (that is, $\psi = 1$).
In addition, we assume a steady-state allocation of 80 percent of the time endowment to leisure and 20 percent to work effeort. This value is consistent with an intertemporal elasticity of substitution in leisure (ϑ) equal to 4.17.[23] Similarly, in the present study, values for preference parameters θ and γ are equal to the values used in previous quantitative studies (0.30, see, for instance, Finn [30]).
In order to examine the responses of the economic performance of a representative oil producing country to a shock in oil revenues and government consumption expenditure, steady-state ratios are obtained by considering the average values of the statistics for the countries considered in the analysis

[22] However, it is worth observing that, for these countries, statistics are often not reliable as they vary significantly across countries as far as quality, measurement, coverage of data is concerned. Statistics on economic data are also not regularly collected.

[23] Since to our own knowledge, no reliable statistics referring to these parameters for GCC countries is available, this parameter is selected on the basis of previous literature.

(see Table 1). In particular, shares of consumption and investment in total output from the Penn's World Tables for the GCC countries provide the values of $\frac{C}{Y}$ and $\frac{I}{Y}$ reported in columns two and three of Table 1.[24] Similarly, column four of Table 1 shows the steady-state ratio Z/Y (share of hydrocarbon revenues in GDP) for all countries examined computed by using World Bank statistics.

The values for the depreciation rates δ_P and δ_G (respectively 0.097 and 0.0285) are chosen in order for the economy's steady-state private and public investment-to-output ratios (I/Y and X/Y) to coincide with the average values observed for the GCC countries (that is, 0.21 and 0.07, respectively). Accordingly, we are able to set the steady-state ratios K^P/K and Y^P/Y to be equal to 0.46 and 0.63, respectively. [25].

Finally, based on statistics based on International Labour Organization data the percentage of workers employed in the public sector on total employees on average is equal approximately to 0.30.

[INSERT TABLE 1 ABOUT HERE]

[24] In what follows, constant steady-state values of relevant variables are denoted by employing symbols without the time subscript.

[25] Equations (5) and (16) implies that investment in the steady-state is given by $I^i = \delta^i \cdot K^i$ where $i = \{P,\ G\}$. The steady-state capital stock of the private sector is given by:

$$K^P = N^P \cdot (1/Y_K^P)^{(1/(1-\theta))} \text{ (A)}$$

where:

$$Y_K^P \equiv Y_P/K_P = (R - 1 + \delta^P)/\theta \text{ (B)}$$

If we solve eq. A to obtain Y_K^P we get the following equation:

$$Y_K^P = N^P/exp(-log(K^P/N^P) \cdot \theta)/K^P \text{ (C).}$$

If we substitute C in B and solve for K^P we get:

$$K^P = exp(log((R - 1 + \delta^P)/\theta)/(-1 + \theta)) \cdot N^P$$

where $R = 1/\beta$. A similar process is followed to determine K^G. Values for parameters δ_P and δ_G are, then, chosen such that the resulting ratio I^P/I^G satisfies the steady-state level reported in Table 4 (in our example three).

At the purpose of replicating the responses of a representative oil producing country, the parameters of autocorrelation process of the shock processes employed coincide with the values obtained by estimating AR(1) processes for oil revenues and government consumption expenditure for each GCC country. Based on simple regression analysis based on Energy Information Administration, International Monetary Fund and World Bank data (see Table 2) we obtain as estimates for ρ_Z, ρ_G, $\sigma_{\epsilon Z}$ and $\sigma_{\epsilon G}$ average values equal to 0.86, 0.86, 0.22 and 0.09, respectively - see Table 3. These results suggest that the goverment consumption expenditure shows lower variability in coefficient estimates with respect to oil revenues. In addition, goverment consmption in Kuwait displays a smaller degree of autocorrelation than its counterparts. In fact, notice that the sample used in our analysis includes the experience of the first Persian Gulf war. Finally, according to our results, we are able to assume that there is not correlation between the two exogenous shocks (that is, $corr\,(\epsilon Z,\ \epsilon G) = 0$).

[INSERT TABLES 2 AND 3 ABOUT HERE]

Table 4 shows all parameters and steady-state values for the relevant variables used in calibrating the model to represent our "average" oil producing country.

[INSERT TABLE 4 ABOUT HERE]

3.2. Simulation

The behaviour of relevant variables over 1000 samples is simulated over annual data by using the system of linear equations obtained from the solution of our theoretical framework (see Section 2.2). Since we have a set of both linear and nonlinear equations, in order to solve for the system we need to approximate it by a corresponding set of linear equations. In particular, all equations that represent the Ramsey equilibrium have to be log-linearized around the non-stochastic steady-state of the economy using standard methods for linear dynamic equations (see, King et al. [31]).[26]

Each sample generated had the same number of periods (30) as the time

[26]The system of linear equations obtained by considering the assumptions of our theoretical model together with the momentary utility function of the household given by equation 2 are available from the authors upon request.

series employed in the study. The recursive method proposed by Binder and Pesaran [32] and the Hodrick-Prescott technique are employed, respectively, to simulate the model and to filter the models samples.

Tables 5 and 6 shows the statistical properties of the economies examined in the present study as summarized by a set of standard deviations and correlations with output. In the first panel of Table 5 we report the statistics for the GCC economies. The second column in the second panel of the table shows the standard deviations of our "average" oil exporting country whereas the statistics which describe the economy resulting from our model are reported in the third column.

[INSERT TABLE 5 ABOUT HERE]

When the statistics based on actual data and those obtained by simulating our economy are compared it can be noticed that both displays significantly larger fluctuations for private consumption, government consumption and oil revenues with respect to output. On the contrary, our model produces simulated data for labour that are characterized by smaller fluctuations with respect to actual data. On the contrary, fluctuations of simulated data for investment are larger than those associated to actual data.[27]

Table 6 shows the correlation of relevant variables with output. On the basis of actual data, statistics are shown for each oil producing country considered in the analysis as well as our "average" oil exporting country (first panel and column two in the second panel, respectively). Table 7 presents the selected autocorrelations of the simulated series calculated from the estimated spectral density matrix.

[INSERT TABLES 6 AND 7 ABOUT HERE]

Both the actual data and the theoretical model predict that the consumption, labour and government consumption are correlated positively with output. On the contrary, the level of total investments as well oil revenues in the model is countercyclical, that is, the correlation of these variables with Y_t is less than zero. The negative correlation between oil revenues and output

[27] These results needs, however, to be interpreted with caution because of the small number of observations employed in our analysis as well as measurement errors that may affect official statistics. See note 22.

arises from the assumed correlation of oil revenues and employment rates observed both in simulated data (see Section) and in previous studies. In fact, since the mid-1980s, in these countries, economic growth has decelerated while conditions in the labour markets have worsened (see, Fasano-Filho and Goyal [33]).
Results from the simulation of the RBC model for the GCC countries suggests that C_t, N_t and G_t are important "inverted"[28] leading indicators of output, that is there exists a negative relationship between v_t (here, $v_t = C_t,\ N_t,\ G_t,\ Z_t$) and Y_t (that is, $corr(v_t, y_{t+2}) < 0$.

3.3. Quantitative results

This Section presents the main intuition on how oil shocks and fiscal policy affect the economic performances of oil exporting countries. In particular, we discuss the key qualitative effects of one-time innovations to each of our two exogenous variables: Z and G. Table 8 summarizes the effects of the two shocks on both private and public sectors.

[INSERT TABLE 8 ABOUT HERE]

Effects of exogenous oil shocks

Figures 1 to 5 show the percent deviation from steady-state which results from a one percent change in oil revenues.
A positive innovation shock to oil revenues is argued to cause an instantaneous increase in investments by the government. Similarly, as a result of the increase in oil revenues, both employment in the public sector and demand of capital by the government strongly increase.
This result matches the historical experience of GCC countries (see, for instance, Fasano-Filho and Wang [35], Fasano-Filho and Wang [36] and Fasano-Filho and Iqbal [12]). These countries, in fact, often associate increases in oil revenues with an expansionary fiscal policy. In particular, government spending rises in tandem with oil revenues often through a massive investment program in infrastructure. While in the region the expansion of public capital positively impacted the economic performances of these countries, in other resource-rich countries revenues from booms were mostly consumed rather than invested. For these economies, commodity booms have usually

[28] See King and Watson [34].

resulted in slower economic growth over the medium term (see Sachs and Warner [2]).
In addition, results suggest that the oil shock reduces the productivity of private capital and discourages more investment by the private sector. In fact, it can be noticed that, because of increases in interest rates, the process of accumulation of capital by the private sector slows significantly.
However, because of the positive effect of the oil shock on the stock of public capital, the total capital endowment of the economy starts increasing after approximately six years from the oil shock. This effect is well known in the existing literature on the "natural resource curse" (see, for instance, Auty and Gelb [37] and Eifert et al. [14]). In fact, mainly because of a high level of non-wage income (e.g. social spending and low taxes) the abundance of natural resources is often associated with negative effects on incentives by economic agents to accumulate capital (in particular, human capital).
Total labour market dynamics over the business cycle are mainly explained by the positive effects of oil shocks on the supply of labour in the public sector and its average productivity.[29]
Nevertheless, it is worth noticing that the exogenous increase in external revenues received by the government produces an important sectoral reallocation between the private and public sector. In particular, the oil shock causes a transfer of labour from the private to the government sector: while oil revenues boost the number of employees in the public sector, employment in the private sector responds negatively to the oil shock.
All in all, although the number of employees in sectors like defence, public administration and health increases, total employment decreases significantly driven by lower employment rates in the private sector.[30]
With regard to the consequences of the oil shocks on total output, oil rev-

[29] The magnitude of the increases in employment is strongly related to the size of marginal productivity of factors in the two sectors. The diminishing marginal product of labour in the public production function determines the reallocation of factor across sector.

[30] Rising unemployment in GCC countries is studied, for instance, in Fasano-Filho and Goyal [33]. In particular, they notice that in these countries the private sector employs a significant number of workers. However, during the period 1996-2000 "the public sector has continued to account for more than three-fourths of employment growth in Kuwait and about one-half in Saudi Arabia."

enues increase the role of the government in the economy. In fact, according to the reduction in employment and in the stock of capital in the private sector, private output falls significantly. On the other hand, public output strongly increases.
Finally, the simulation of our model suggests that the oil shock has an overall negative effect on economic performances of oil exporting countries. A likely explanation of this evidence lies in the fact that the number of employees in the economy responds negatively to higher oil revenues.
In addition, the results of our simulation exercise support the view that an oil shock is also associated with decreases of both wages and private consumption. Because of the effects of the oil shock on total employment, a rise in government spending does determine the usual crowding-out effects on private demand for consumption goods.[31]

[INSERT FIGURES 1 TO 5 ABOUT HERE]

Effects of shocks to government consumption expenditure

The main effect of a shock to government consumption expenditure on oil producing economies is a positive wealth effect. In fact, although more of the economy's goods are consumed by the government, a positive innovation to G causes an increase in private consumption. The main explanation for this relationship is that higher expenditure by the government causes private employment to expand. Employment increases also as a consequence of higher wages. As the increase of private employment raises capital's future marginal productivity and interest rates fall, the incentive to invest by the private sector increases as well. Finally, with regard to the impact to output, since investments boost the level of the capital stock, a shock to G is argued to have a strong positive impact on private production.
As far as the effects on the public sector are concerned, Figure 6 shows that a shock to government consumption impacts negatively the level of public investments. In other words, spending practices aimed at increasing government consumption could reduce incentives to the accumulation of (physical

[31] Similarly, in an analysis of the effects of fiscal policy in advanced countries, Gali et al. [38] describes the different responses that affect government expenditure in advanced economies. He argues that the crowding-out effects of consumption in response to a rise in government spending is due to the full-flexibility of prices and (or) the intertemporal optimization problem faced by households.

as well as human) capital by the public sector.
Over time, the reduction in I_t^G causes the level of public capital to decrease. However, employment in the public sector increases significantly in the first six years after the shock.[32] As the reduction in the stock of public capital is more than compensated by the expansion of public employment, public output responds positively to a shock in government expenditure. However, as the effects on public employment decrease over time, the overall effect of the shock on public output becomes negative after approximately three years.
As we have seen, the accumulation of private and public capital move in opposite directions. As the decrease in public investment is more important than the changes that affect the private sector, the overall instantaneous effect on total investments is argued to be negative. Similarly, the negative effect of the shock to G on the level of public capital is not compensated by a corresponding increase in the stock of private capital. Consequently, the model predicts a negative effect of a shock on government consumption on the total stock of capital. In addition, increases in wages are argued to have no particular effects on total labour. Total employment increases despite the reduction in the number of employees in the public sector. Finally, because of the combined effects of the shock on private and public production, the model asserts that expansionary fiscal policy has a positive impact on total output despite decreases in capital expenditure.[33, 34]

[32] As Fasano-Filho and Wang [35] notice for GCC countries, oil booms enhance the "role of the government as the main provider of jobs for nationals".

[33] Previous theoretical and empirical literature shows that increases in capital expenditure will either raise or lower economic growth. This effect depends on several factors such as the size of the government, how the fiscal policy is financed, whether or not the public capital "crowds-out" private investments. For instance, Devarajan et al. [39] argue that, often because of excessive expenditure, the relationship between public expenditure on capital and per capita growth of developing economies is negative. On the contrary, Munnell [40] find that public investments have a significant, positive impact on output. In fact, the positive effects on employment growth and on the productivity of private capital tend to offset the possibility that crowding out effects on private investment emerge.

[34] According to other studies (see Barro [41]) an increase in government consumption leads to a lower economic growth rate as a higher level taxation is not associated with an increase in the productivity of the private sector.

[INSERT FIGURES 6 TO 10 ABOUT HERE]

3.4. Sensitivity analysis

In this Section the sensitivities of the results to overall oil shocks on our economy to changes in key parameters with respect to those presented in Table 4 are explored. Two simulation exercises are, thus, considered. In the first exercise, the results on the simulation exercise are presented by considering how results changes as parameter ψ varies. That is, by considering different positive effects arising to households from different type of fiscal policy. In the second exercise, different assumptions on the size of governments are considered. In this case, results are displayed by simulating our model under the assumption of different steady-state values for $\frac{C+I^P}{Y}$, that is, the ratio between private demand for consumption and investments and output.

How does the economy responds to a positive oil shocks if the utility function of households is assumed to depend on government consumption? How do these responses depend on the values assumed by parameter ψ? As we have seen from equation (2), parameter ψ represents the degree of substitutability between private and public consumption in the utility function of the representative agent. Consequently, by decreasing ψ the degree of substitutability between G and C increases.

Tables 9 and 10 shows standard deviations of simulated series and their correlations with output assuming different values of parameter ψ. Table 9 shows that as ψ decreases, fluctuations of all economic variables increases. On the contrary, changes in the degree of substitutability of private with public consumption affect significantly the cyclical characteristics of simulated series (see Table 10). In particular, lower values of ψ have as their main effects to make total investments and capital procyclical. Moreover, while the degree of correlation of private investment and output increases, the negative relationship between public investments and output, as well as that between oil revenues and output, strengthens.

In this subsection the model economy is simulated under the counterfactual assumptions that the size of the public sector is different with respect to the that can be observed in an average oil exporting countries. In particular, Tables 11 and 12 show how results vary if changes on the assumptions on the

size of the public sector of oil exporting countries are made.[35] As the role of the government in the economy increases, fluctuations of total output, consumption and labour decrease. The most noticeable result of the sensitivity analysis shows that, as the role of the private sector decreases, the degree of correlation between oil revenues and output increases.
Moreover, results shown in Table 12 suggest that the correlation between output and private investment (or capital) decreases as the role of the government in the economy increases. On the other hand, the relationship between investments by the government and output falls.

[INSERT TABLES 11 AND 12 ABOUT HERE]

All in all, the possibility to reduce the negative effects of exogenous oil shocks on the economic growth of oil exporting countries are guaranteed under certain assumptions on key parameters. When compared to the results obtained by simulating the benchmark economy (see Figures 11-10), Figures 11-14 allow us to assess the effects of the alterations in parameter values on total investments, capital, labour and output.
As the degree of substitutability between public and private consumption increases, the overall effects associated to an exogenous oil shock decrease. This suggests that governments in GCC countries may reduce the negative effects by providing consumption goods (or public services, like health) that enter more directly in the utility function of households.
Finally, our exercise of simulation suggests that, after an exogenous oil shock, countries which are characterized by a smaller size of governments in steady-state tend to react more significantly to oil price shocks. Moreover, our results do support the possibility that the negative economic effects from an oil shock can hardly be reduced by decreasing the direct (i.e. productive) intervention of government in the productive activities of the country. The negative effects do not decrease proportionally when the size of governments in these economies is reduced. Furthermore, in countries with smaller governments, expansionary fiscal policy is associated to higher positive effects on total investments and, consequently, on ouput.

[INSERT FIGURES 11 AND 14 ABOUT HERE]

[35]In particular, the ratio $(C+I^P)/Y$ is assumed to take the following values: 0.67, 0.64 (benchmark case), 0.58, 0.51 and 0,45.

4. Concluding remarks

Exogenous oil shocks are often argued to negatively affect the economic stance of producing countries. The main thesis we present in this paper is that, in order to evaluate the impact on the economic performances of an oil producing country, a researcher must address the negative wealth effects and the reallocation process caused by the fiscal policy implemented by the government.

Through a simple RBC model we assess that oil price shocks can imply a strong negative wealth effect on the private sector. Because of the shift of productive factors from the households and firms to the government sector, private employment and output respond negatively to the oil shock. In other words, a crowding-out effect on private investment arises as a consequence of the net wealth effect due to changes in oil revenues. Moreover, since the negative effects on private investment, output and employment are not compensated by the positive impact which derives from the employment policy by the government, fluctuations of oil revenues cause overall output to shrink.

With regard to the effects of a shock to government consumption expenditure, results from the simulation of our model suggest that private employment responds positively to an expansionary fiscal policy. Similarly, as higher investments by the private sector increase and the level of both capital and employment in the private sector expands, private production is positively affected by a shock to government expenditure.

Moreover, a shock to government consumption has a negative impact on the level of public investments and, consequently, the stock of public capital to decrease. However, as employment in the public sector increases significantly, public output temporarily expands after the expansionary policy implemented by the government.

In sum, total investments and capital decrease after the shock. However, total employment increases despite the reduction in the number of employees in the public sector. This fact allows total output to increase in response to a shock to government consumption expenditure.

In summary, according to the results of our model and previous studies[36], GCC countries should reduce the adverse effects of abrupt shifts in oil rev-

[36]See, for instance, Fasano-Filho and Wang [35] Fasano-Filho and Wang [36] and Fasano-Filho and Iqbal [12].

enues on the structure of their economies. At this regard, fiscal policy should be aimed at preventing the role of the private sector from shrinking excessively. Controls on investments by the private sector in oil producing countries have recently been significantly reduced. However, constraints on the possibility by private agents to operate in these countries continue to hinder economic growth. At this purpose, measures directed at reducing restrictive domestic trade and competition practices[37] should be implemented to support privatizations of domestic sectors. Similarly, the establishment of a well functioning competitive market system, a proper definition of property rights and the development of a more efficient regulatory framework represent possible measures that governments in oil exporting countries should pursue in order to open financial markets to foreign investors.

This paper faces several questions with regard to the implementation of fiscal policy in oil exporting countries. However, our analysis could be enriched along several directions. In particular, future research could be aimed at formulating additional guidelines for government spending decisions which arise from the flow of oil revenues. In order for producing nations to reduce the negative effects arising from the high volatility and uncertainty of oil revenues, according to Barnett and Ossowski [13], the government should target the non-oil balance. The accumulation of financial wealth over the period of oil production could enable producing countries to face in a proper manner the challenges arising from oil shocks. The introduction of these aspects in a more complete theoretical framework represents an interesting topic for future studies.

[37] As well as to enhance the process of economic liberalization of domestic sectors.

Tables

Table 1: Data referring to the economic structure of GCC countries.

Country	C/Y (1)	I^P/Y (1)
Bahrain	45.73% (2005-2006)	19.92% (2005-2006)
Kuwait	37.25% (2005-2007)	19.38% (2005-2007)
Oman	54.54% (2005-2007)	13.42% (2005-2007)
Qatar	30.88% (2005-2007)	31.95% (2005-2007)
Saudi Arabia	41.40% (2005-2007)	13.03% (2005-2007)
U.A.E.	44.21% (2005-2007)	28.79% (2005, 2007-2008)
Average (6)	42.34%	21.08%

Country	Z/Y (2), (3)	I^G/Y (2), (4)	N^G/N (5)
Bahrain	60.38% (2005-2007)	4.14% (2006-2008)	25.30% (2001)
Kuwait	52.92% (2006-2007)	5.56% (2005-2006)	23.80% (2003)
Oman	53.92% (2005-2008)	8.87% (2005-2006)	64.40% (2000)
Qatar	53.24% (2005-2007)	7.27% (2005)	16.40% (2006)
Saudi Arabia	53.71% (2005-2007)	9.05% (2005-2008)	34.85% (2006-2007)
U.A.E.	57.75% (2005-2007)	7.19% (2005-2008)	13.40% (2005)
Average (6)	55.32%	7.23%	29.69%

Notes.

(1) Source: Penn's World Tables.

(2) Source: World Development Indicators, World Bank.

(3) Hydrocarbons revenues are obtained by multiplying the amount of fuel revenues as a percentage of merchandise exports by the ratio between merchandise exports and GDP.

(4) Total public investment is proxied by the total spending on education.

(5) Source: International Labour Organization, United Nations.

(6) Average is the simple mean of the values for the six countries considered in the analysis.

Table 2: Data on oil revenues for GCC countries. Selected years.

Country	Oil Production (1) (2)	Exchange Rate (3) (4)	GDP Deflator (5) (6)	CPI (5) (6)
Bahrain	48	0.38	9.52%	3.19%
	(2009)	(2009)	(2007-2008)	(2007-2009)
Kuwait	2496	0.29	5.94%	6.64%
	(2009)	(2009)	(2007)	(2007-2009)
Oman	816	0.38	16.62%	7.27%
	(2009)	(2009)	(2007-2008)	(2007-2009)
Qatar	1213	3.64	19.13%	7.58%
	(2009)	(2009)	(2006)	(2007-2009)
Saudi Arabia	9763	3.75	-0.93%	6.34%
	(2009)	(2009)	(2007-2009)	(2007-2009)
U.A.E.	2795	3.67	8.39%	n.a.
	(2009)	(2009)	(2007-2009)	

Notes.

(1) Thousand barrels per day.

(2) Source: Energy Information Administration, U.S. Department of Energy.

(3) National currency per U.S. dollar. All GCC countries are characterized by a fixed exchange rate against the U.S. dollar.

(4) Source: International Financial Statistics, International Monetary Fund.

(5) Source: World Development Indicators, World Bank.

(6) Year-on-year percentage changes.

Table 3: Estimation of $AR(1)$ models of oil revenues and government consumption expenditure.

Country	Sample	ρ_Z	$\sigma_{\epsilon Z}$
Bahrain	1994 - 2008	0.97	0.21
Kuwait	1994 - 2007	0.90	0.19
Oman	1994 - 2008	0.80	0.19
Qatar	1994 - 2009	0.88	0.25
Saudi Arabia	1994 - 2009	0.82	0.23
U.A.E.	1994 - 2009	0.76	0.24
Average (1)		0.86	0.22

Country	Sample	ρ_G	$\sigma_{\epsilon G}$
Bahrain	1980 - 2006	0.80	0.09
Kuwait	1980 - 2007	0.63	0.10
Oman	1980 - 2007	0.86	0.10
Qatar	1980 - 2007	0.96	0.13
Saudi Arabia	1980 - 2007	0.93	0.06
U.A.E.	1980 - 2007	0.96	0.07
Average (1)		0.86	0.09

Notes.

ρ_X and $\sigma_{\epsilon X}$ denote the coefficient associated to the lag value of the dependent variable and the variance of the error term, respectively of an AR(1) model for $X = \{Z,\ G\}$ (see equations 18 and 19).

(1) Average is the simple mean of the values for the six countries considered in the analysis.

Table 4: Parameters and steady-state values for a representative oil producing country.

a) Parameter	
Preferences	$\beta = 0.96$
	$\sigma = 2$
	$\psi = 1$
	$\vartheta = 4.17$
Production	$\theta = 0.30$
	$\gamma = 0.30$
	$\delta_P = 0.097$
	$\delta_G = 0.0285$
Exogenous shocks	$\rho_Z = 0.86$
	$\sigma_{\epsilon Z} = 0.22$
	$\rho_G = 0.86$
	$\sigma_{\epsilon G} = 0.09$
	$corr\,(\epsilon Z,\ \epsilon G) = 0$
b) Steady-state Variables	
Private Sector	$Y = 1.00$
	$C/Y = 0.43$
	$I^P/Y = 0.21$
Government	$G/Y = 0.29$
	$(WN^G)/Y = 0.19$
	$I^G/Y = 0.07$
Oil Sector	$Z/Y = 0.55$
Market Clearing Condition	$N = 0.20$
	$N^P/N = 0.70$
	$K^P/K = 0.46$
	$Y^P/Y = 0.63$
	$N^G/N = 0.30$
	$K^G/K = 0.54$
	$Y^G/Y = 0.37$

Note.
This Table shows the values of parameters and steady state variables used in the simulation exercise.

Table 5: Standard deviations of selected economic variables.

Variables	Bahrain	Kuwait	Oman	Qatar
Total output	0.060	0.128	0.041	0.096
Consumption	0.099	0.369	0.100	0.133
Total investment	0.318	0.359	0.182	0.258
Total labour	0.006	0.010	0.009	0.013
Gov. consumption	0.045	0.201	0.069	0.144
Oil revenues	0.208	0.189	0.195	0.212

Variables	Saudi Arabia	U.A.E.	Average (1)	Simulated data
Total output	0.081	0.070	0.079	0.052
Consumption	0.059	0.074	0.139	0.092
Total investment	0.181	0.075	0.229	0.044
Total labour	0.009	0.005	0.009	0.073
Government consumption	0.113	0.109	0.114	0.059
Oil revenues	0.203	0.202	0.201	0.145

Note.

(1) Average is the simple mean of the values for the six countries considered in the analysis.

Table 6: Contemporanous correlation with output of selected economic variables. Actual data.

Variables	Bahrain	Kuwait	Oman	Qatar
Total output	1.00	1.00	1.00	1.00
Consumption	0.336	-0.016	0.043	0.634
Total investment	0.728	0.159	-0.200	0.857
Total labour	-0.232	0.667	0.833	0.084
Gov. consumption	0.288	0.092	0.728	0.068
Oil revenues	0.954	0.312	0.167	0.896

Variables	Saudi Arabia	U.A.E.	Average (1)
Total output	1.00	1.00	1.00
Consumption	0.318	0.137	0.242
Total investment	0.624	0.928	0.516
Total labour	-0.877	0.132	0.101
Government consumption	0.511	0.736	0.404
Oil revenues	0.295	0.923	0.591

Notes.

The entries of this Table denote the degree of contemporaneous correlation between output Y_t and the variable v_t reported in column 1 (i.e. $corr(v_t, Y_t)$).

(1) Average is the simple mean of the values for the six countries considered in the analysis.

Table 7: Contemporaneous and non-contemporaneous correlation with output of selected economic variables. Simulated data.

Variables	j=2	j=1	j=0	j=-1	j=-2
Total output	-0.25	0.08	1.00	0.08	-0.25
Consumption	-0.24	0.09	1.00	0.06	-0.27
Total investment	-0.05	-0.11	-0.17	0.16	0.17
Total labour	-0.26	0.08	1.00	0.08	-0.25
Government consumption	-0.17	0.11	0.81	0.00	-0.26
Oil revenues	0.10	-0.10	-0.57	0.02	0.20

Note.
The entries of this Table denote the degree of correlation between output at time t, Y_t and the variable v_t reported in column 1 at time $t+j$ (i.e. $corr(v_{t+j}, Y_t)$ where $j = -2,\ -1,\ 0,\ 1,\ 2$).

Table 8: Effects of an exogenous shock to oil revenues (Z) and to government consumption (G).

Shock to Z	Private sector	Public Sector	Total
Investments	↓	↑ (↓ after 10 years) (1)	↓
Capital	↓	↑	↓ (↑ 6 yrs)
Labour	↓	↑	↓
Output	↓	↑	↓
Consumption	↓		
Wages			↓
Interest rates			↑

Shock to G	Private sector	Public Sector	Total
Investments	↑	↓	↓
Capital	↑	↓	↓
Labour	↑	↑ (↓ 6 yrs)	↑
Output	↑	↑ (↓ 3 yrs)	↑
Consumption	↑		
Wages			↑
Interest rates			↓

Note.

In parenthesis we report when the positive (negative) effect of the shock becomes negative (positive).

Table 9: Standard deviations of simulated economic variables. Sensitivity to degree of substitutability between private and public consumption expenditure (ψ)

Variables	$\psi = 1$	$\psi = 0.75$	$\psi = 0.5$	$\psi = 0.25$	$\psi = 0$
Private capital	0.045	0.046	0.047	0.048	0.050
Public capital	0.036	0.037	0.037	0.038	0.039
Total output	0.052	0.054	0.058	0.062	0.067
Private output	0.073	0.076	0.080	0.085	0.090
Public output	0.048	0.049	0.051	0.053	0.056
Consumption	0.093	0.098	0.104	0.111	0.119
Total investments	0.044	0.046	0.048	0.051	0.054
Private investments	0.445	0.455	0.467	0.480	0.495
Public investments	1.265	1.283	1.303	1.326	1.352
Total labour	0.073	0.078	0.082	0.088	0.095
Private labour	0.089	0.094	0.099	0.105	0.113
Public labour	0.064	0.066	0.068	0.072	0.077
Total capital	0.003	0.003	0.003	0.003	0.003
Wages	0.020	0.021	0.022	0.023	0.025
Interest rates	0.046	0.048	0.051	0.055	0.059
Government consumption	0.059	0.059	0.059	0.059	0.059
Oil revenues	0.145	0.145	0.145	0.145	0.145

Table 10: Contemporaneous correlation with output of relevant economic variables, simulated data. Sensitivity to ψ

Variables	$\psi = 1$	$\psi = 0.75$	$\psi = 0.5$	$\psi = 0.25$	$\psi = 0$
Private capital	0.54	0.56	0.57	0.58	0.59
Public capital	-0.58	-0.59	-0.60	-0.60	-0.61
Total output	1.00	1.00	1.00	1.00	1.00
Private output	0.94	0.94	0.95	0.95	0.96
Public output	0.48	0.50	0.53	0.56	0.60
Consumption	1.00	1.00	1.00	1.00	1.00
Total investments	-0.17	-0.06	0.04	0.15	0.26
Private investments	0.74	0.77	0.80	0.83	0.86
Public investments	-0.80	-0.83	-0.86	-0.88	-0.90
Total labour	1.00	1.00	1.00	1.00	1.00
Private labour	0.98	0.98	0.98	0.98	0.98
Public labour	0.66	0.68	0.70	0.73	0.75
Total capital	-0.04	0.03	0.10	0.17	0.23
Wages	0.96	0.96	0.96	0.97	0.97
Interest rates	-0.96	-0.96	-0.96	-0.97	-0.97
Government consumption	0.81	0.78	0.74	0.71	0.67
Oil revenues	-0.57	-0.62	-0.66	-0.70	-0.73

Note.
The entries of this Table denote the degree of contemporaneous correlation between output Y_t and the variable v_t reported in column 1 (i.e. $corr(v_t, Y_t)$).
The first row indicates how the values of parameter ψ have changed relative to the benchmark case ($\psi = 1$).

Table 11: Standard deviations of simulated economic variables. Sensitivity to the size of the private sector ($\frac{C+I^P}{Y}$)

Variables	$\frac{C+I^P}{Y} = 0.67$	$\frac{C+I^P}{Y} = 0.64$	$\frac{C+I^P}{Y} = 0.58$	$\frac{C+I^P}{Y} = 0.51$	$\frac{C+I^P}{Y} = 0.45$
Private capital	0.055	0.044	0.041	0.042	0.044
Public capital	0.048	0.036	0.027	0.022	0.019
Total output	0.113	0.051	0.023	0.018	0.016
Private output	0.140	0.072	0.04	0.031	0.028
Public output	0.089	0.048	0.041	0.042	0.043
Consumption	0.206	0.092	0.043	0.035	0.034
Total investments	0.058	0.044	0.053	0.066	0.08
Private investments	0.542	0.444	0.411	0.419	0.445
Public investments	1.661	1.264	0.956	0.791	0.678
Total labour	0.162	0.073	0.034	0.026	0.024
Private labour	0.183	0.089	0.044	0.032	0.027
Public labour	0.130	0.063	0.05	0.052	0.054
Total capital	0.002	0.002	0.005	0.008	0.01
Wages	0.045	0.019	0.011	0.011	0.012
Interest rates	0.104	0.045	0.025	0.025	0.028
Government consumption	0.059	0.059	0.059	0.059	0.059
Oil revenues	0.145	0.144	0.144	0.144	0.144

Table 12: Contemporaneous correlation with output of relevant economic variables, simulated data. Sensitivity to the size of the private sector ($\frac{C+I^P}{Y}$)

Variables	$\frac{C+I^P}{Y} = 0.67$	$\frac{C+I^P}{Y} = 0.64$	$\frac{C+I^P}{Y} = 0.58$	$\frac{C+I^P}{Y} = 0.51$	$\frac{C+I^P}{Y} = 0.45$
Private capital	0.62	0.54	0.29	0.06	-0.06
Public capital	-0.63	-0.58	-0.38	-0.19	-0.09
Total output	1.00	1.00	1.00	1.00	1.00
Private output	0.98	0.94	0.80	0.66	0.56
Public output	0.82	0.48	0.23	0.32	0.39
Consumption	1.00	1.00	0.98	0.95	0.92
Total investments	0.60	-0.17	-0.87	-0.90	-0.78
Private investments	0.90	0.74	0.30	-0.10	-0.32
Public investments	-0.92	-0.80	-0.45	-0.12	0.07
Total labour	1.00	1.00	1.00	0.99	0.98
Private labour	0.99	0.98	0.92	0.87	0.85
Public labour	0.90	0.66	0.36	0.41	0.45
Total capital	-0.29	-0.04	-0.02	-0.14	-0.20
Wages	0.99	0.96	0.79	0.70	0.66
Interest rates	-0.99	-0.96	-0.79	-0.70	-0.66
Government consumption	0.66	0.81	0.98	0.95	0.86
Oil revenues	-0.74	-0.57	-0.12	0.26	0.47

Note.
The entries of this Table denote the degree of contemporaneous correlation between output Y_t and the variable v_t reported in column 1 (i.e. $corr(v_t, Y_t)$).
The first row indicates how the ratio $\frac{C+I^P}{Y}$ has changed relative to the benchmark case ($\frac{C+I^P}{Y} = 0.64$).

Figure 1: Effects of exogenous oil shocks.

a) Effects on investments

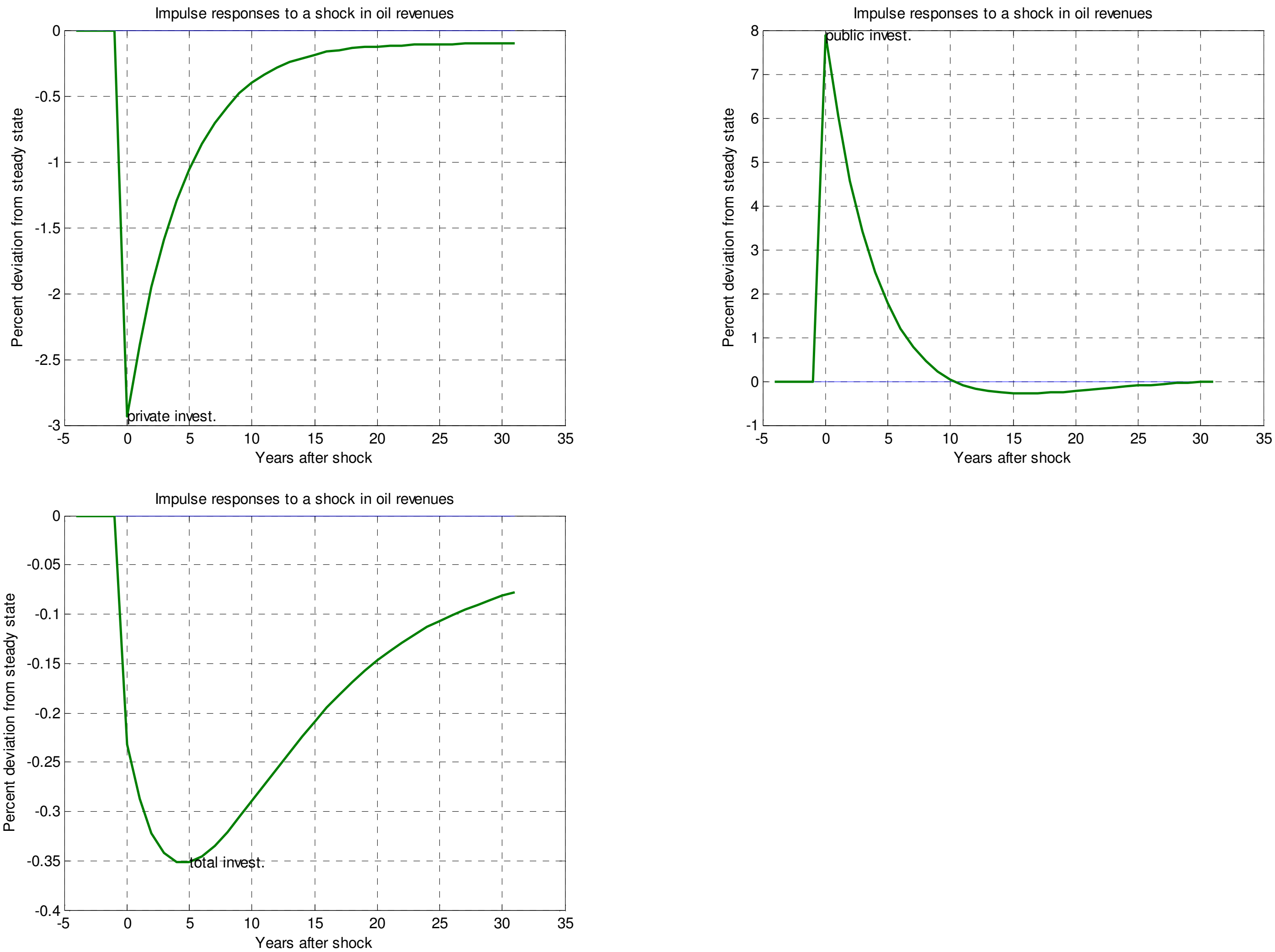


Figure 2: Effects of exogenous oil shocks (ctd).

b) Effects on capital

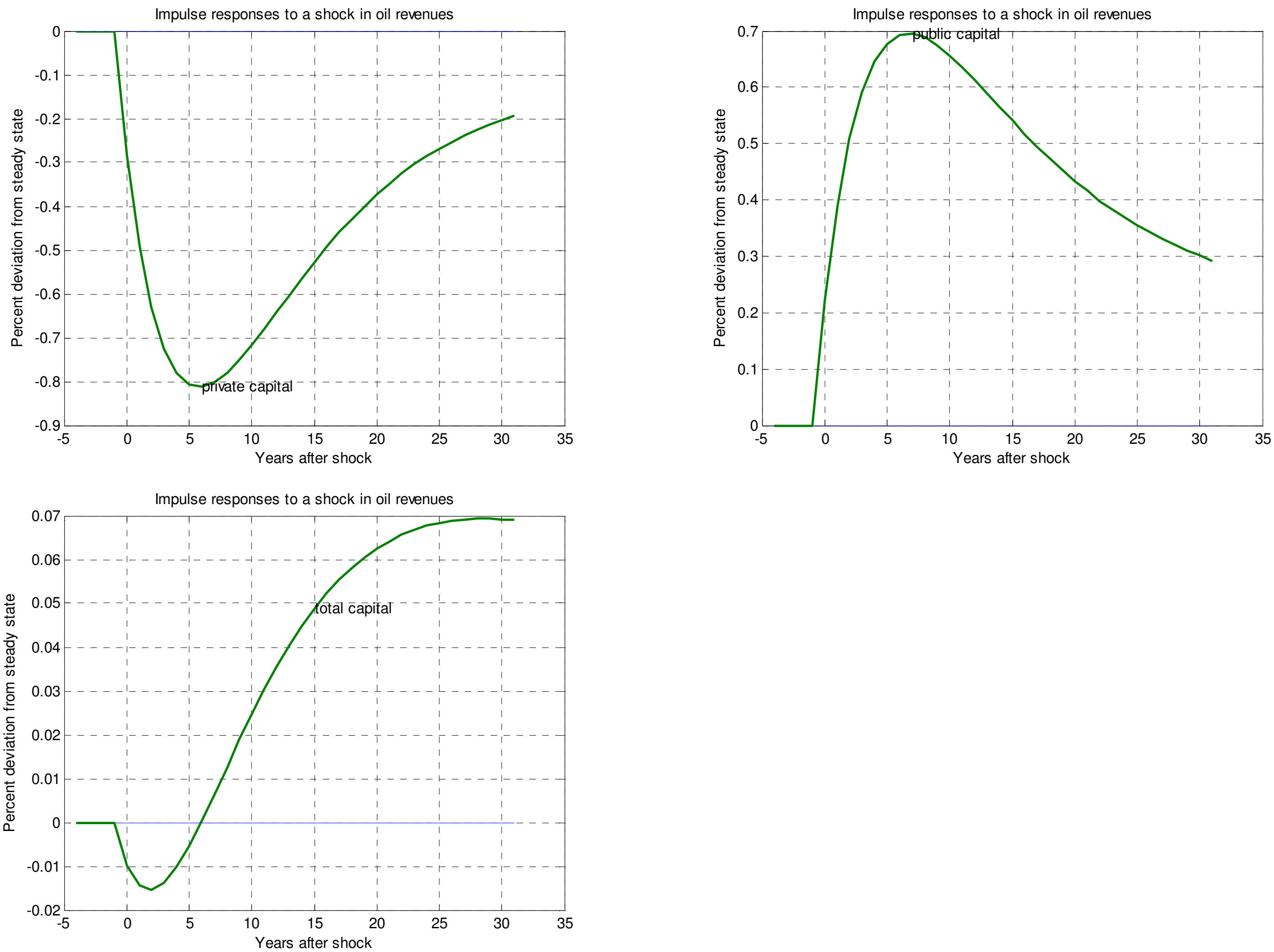


Figure 3: Effects of exogenous oil shocks (ctd).

c) Effects on labour

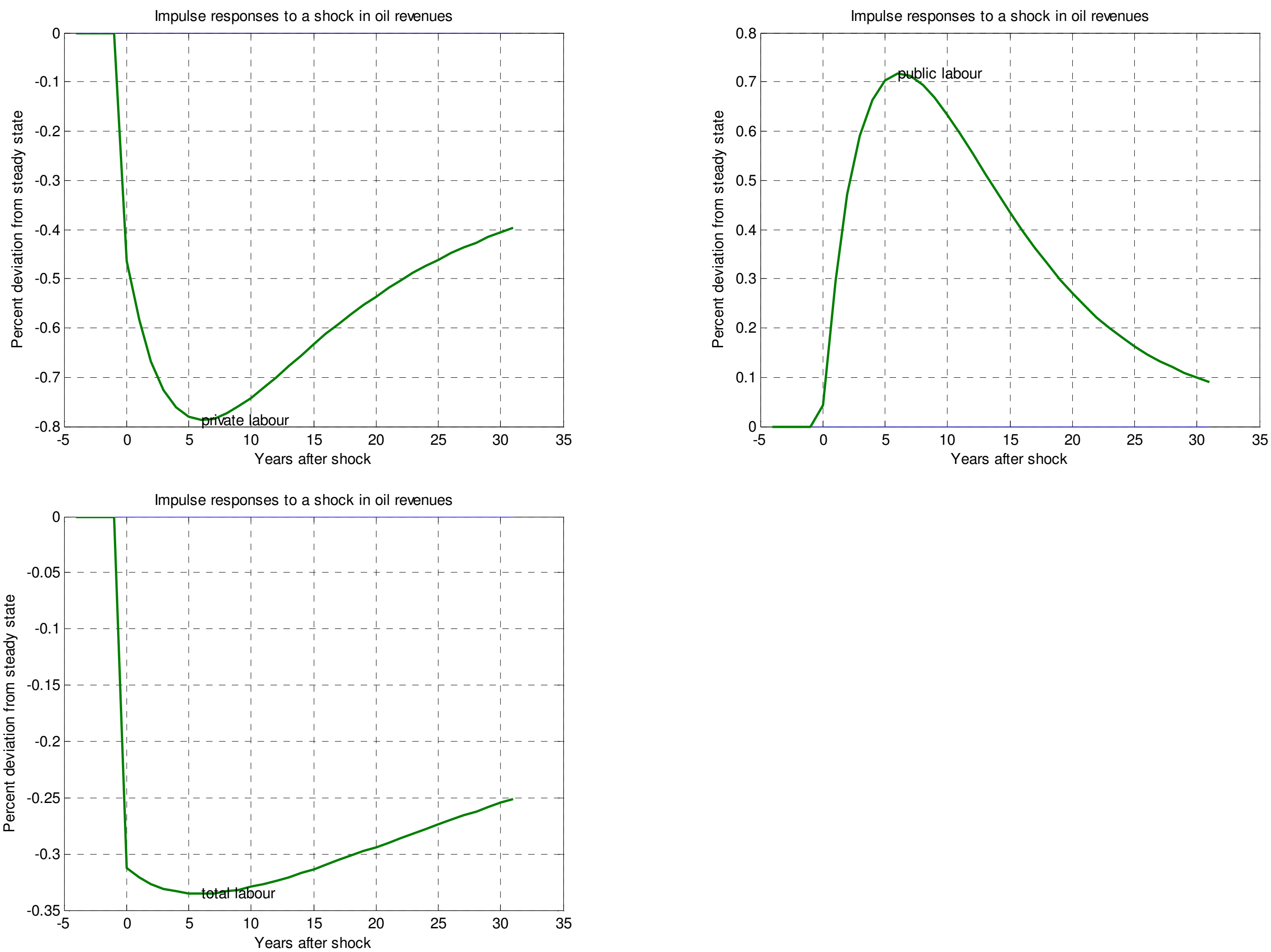


Figure 4: Effects of exogenous oil shocks (ctd).

d) Effects on output

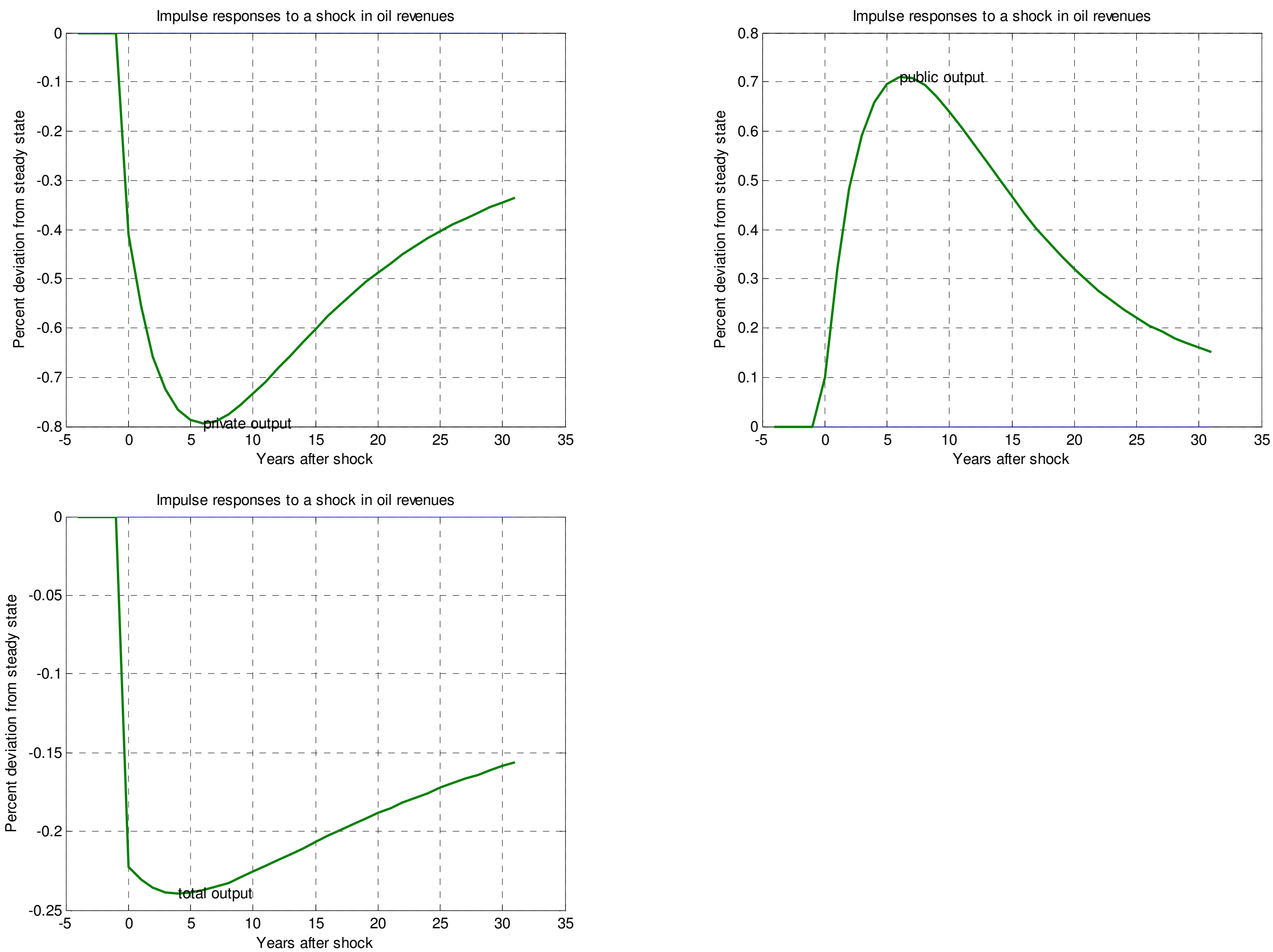


Figure 5: Effects of exogenous oil shocks (ctd).

e) Effects on consumption, wages and interest rates

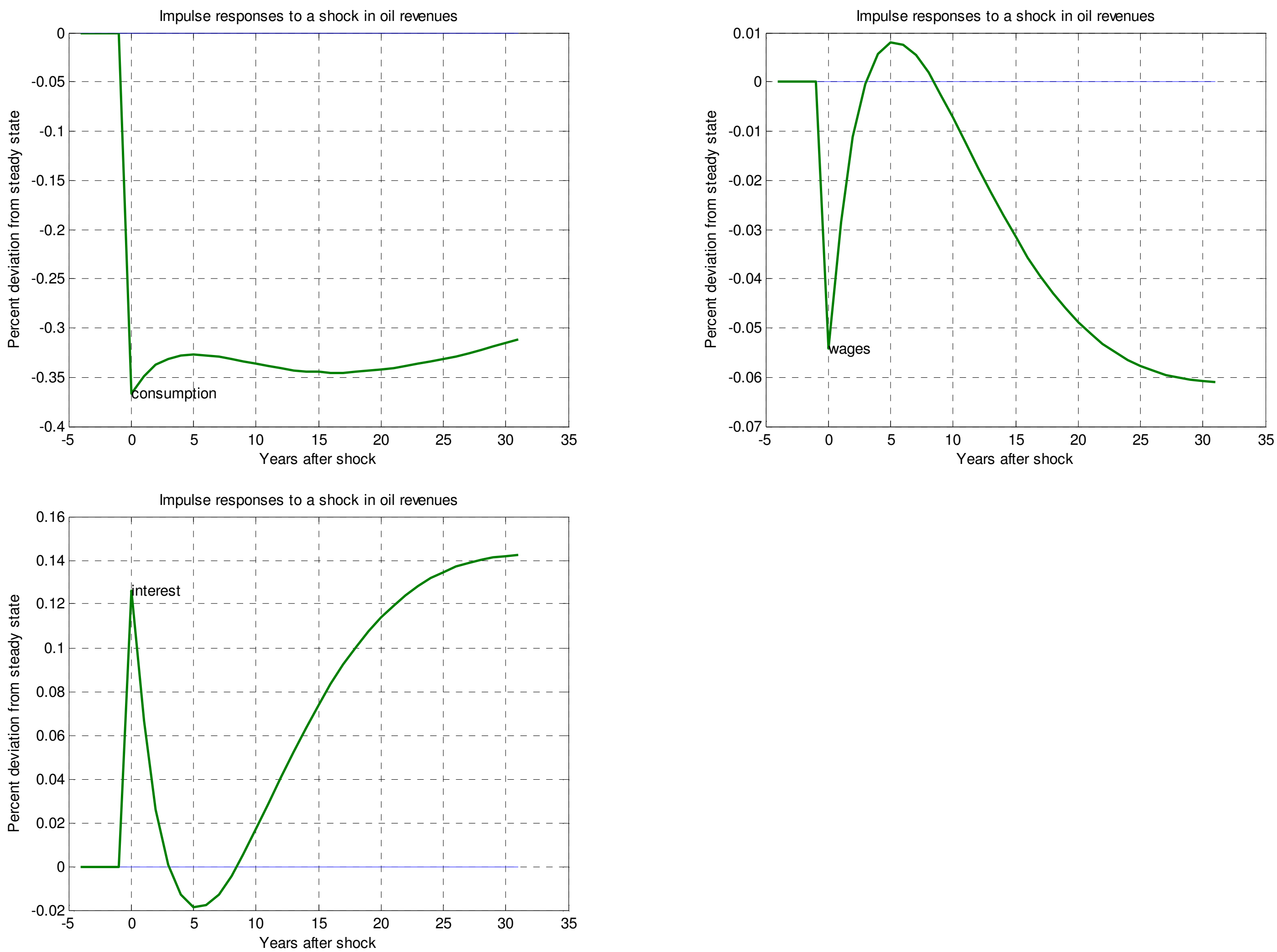


Figure 6: Effects of shocks to government expenditure.

a) Effects on investments

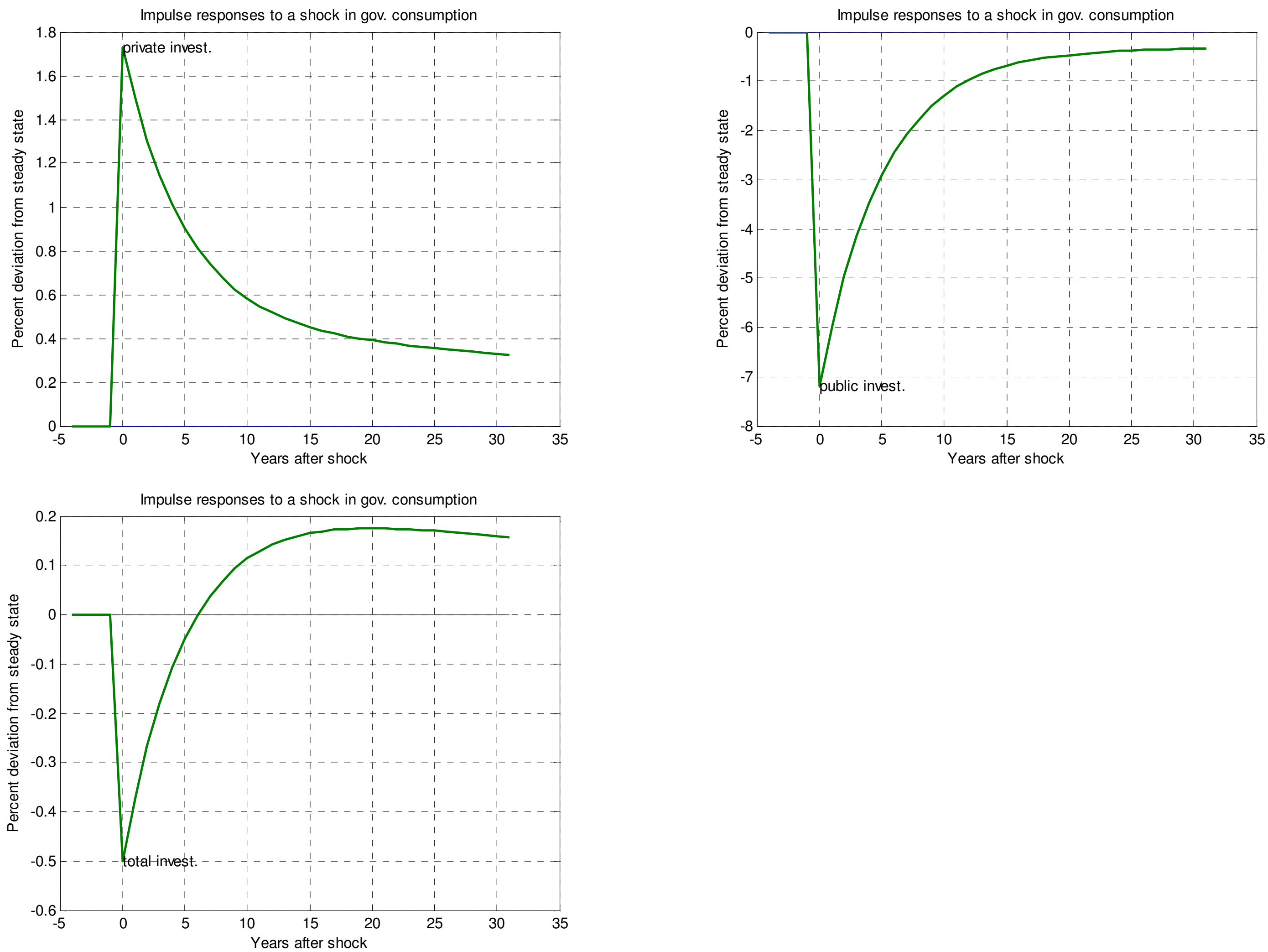


Figure 7: Effects of shocks to government expenditure (ctd).

b) Effects on capital

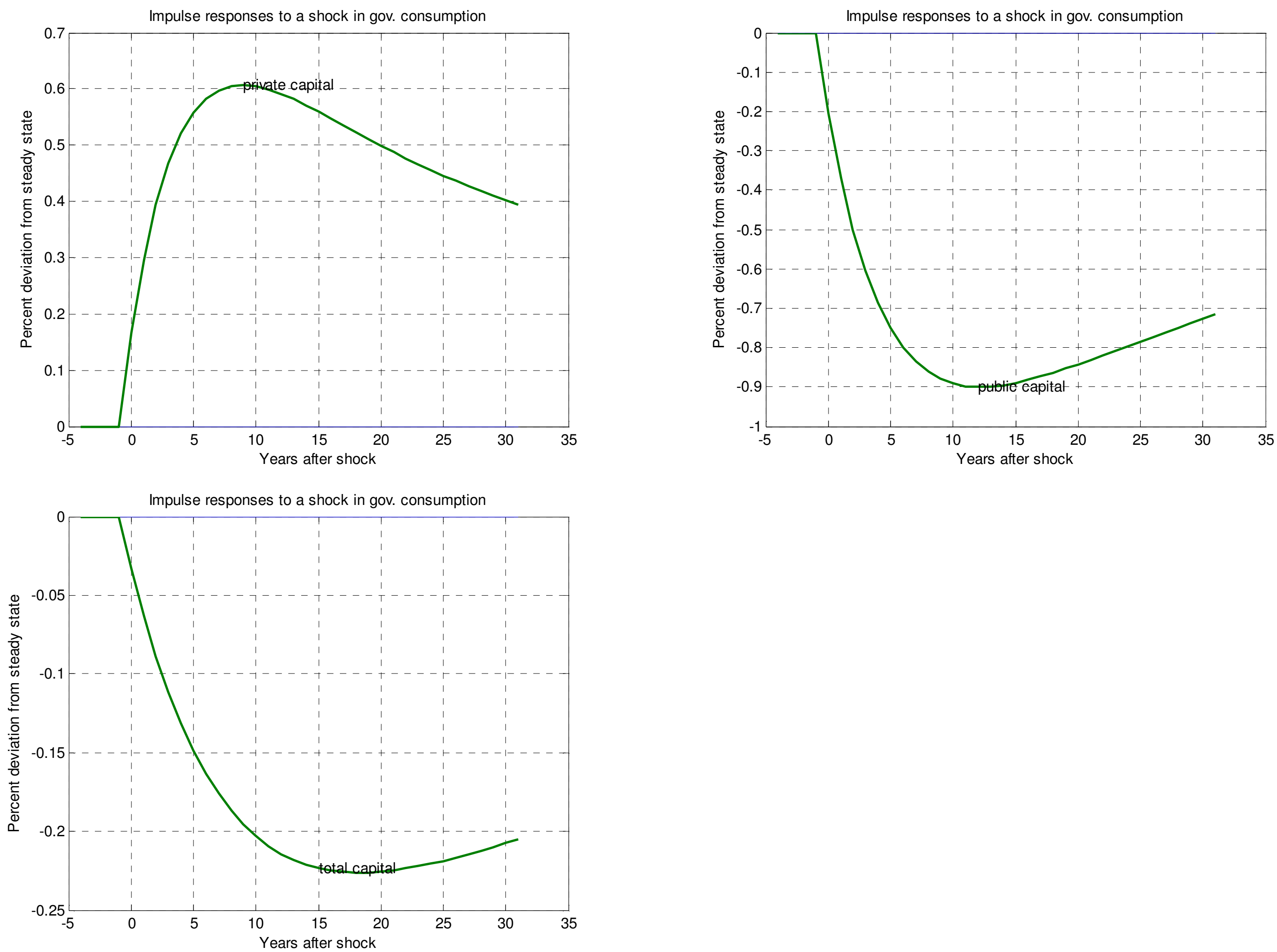


Figure 8: Effects of shocks to government expenditure (ctd).

c) Effects on labour

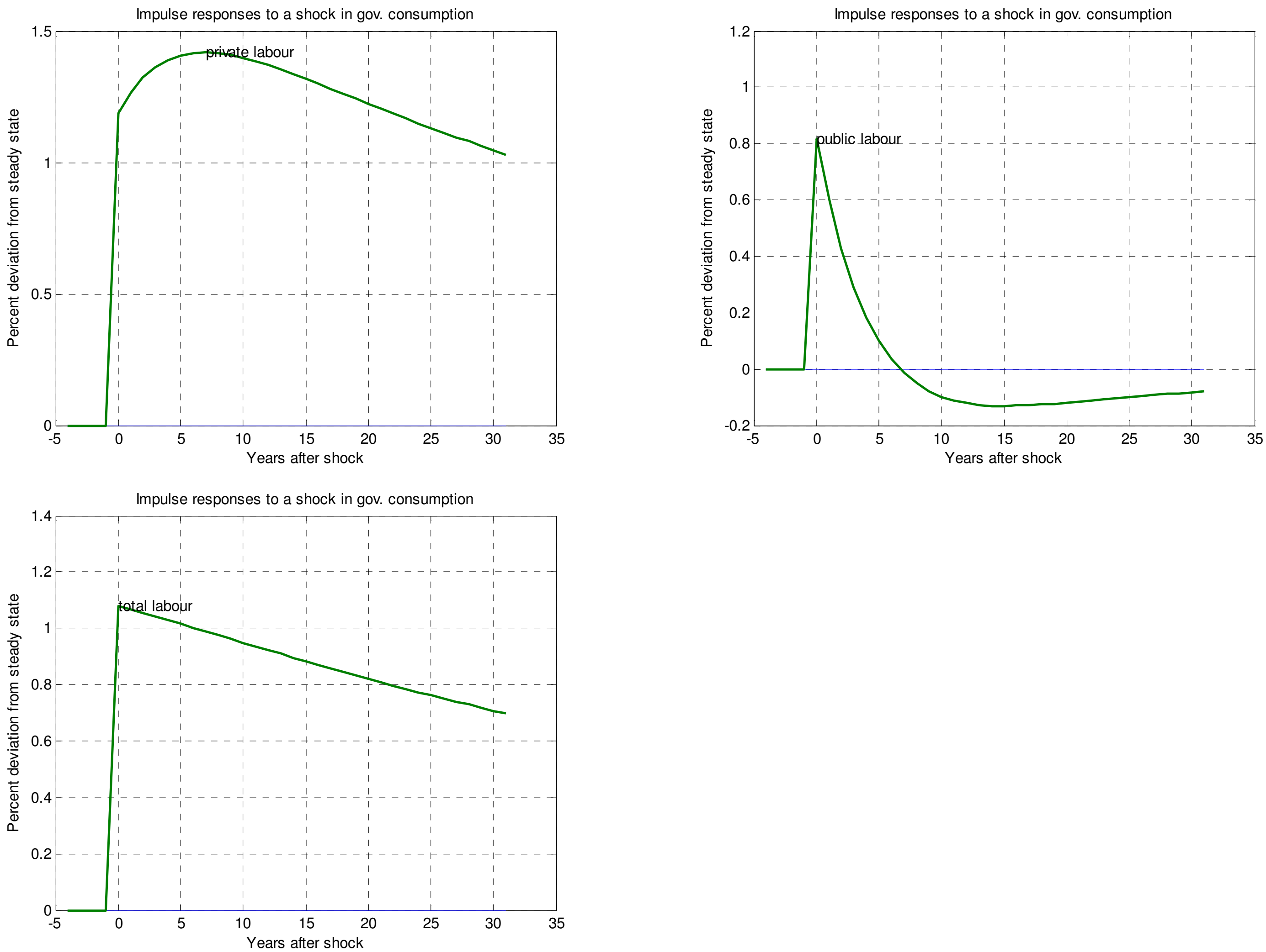


Figure 9: Effects of shocks to government expenditure (ctd).

d) Effects on output

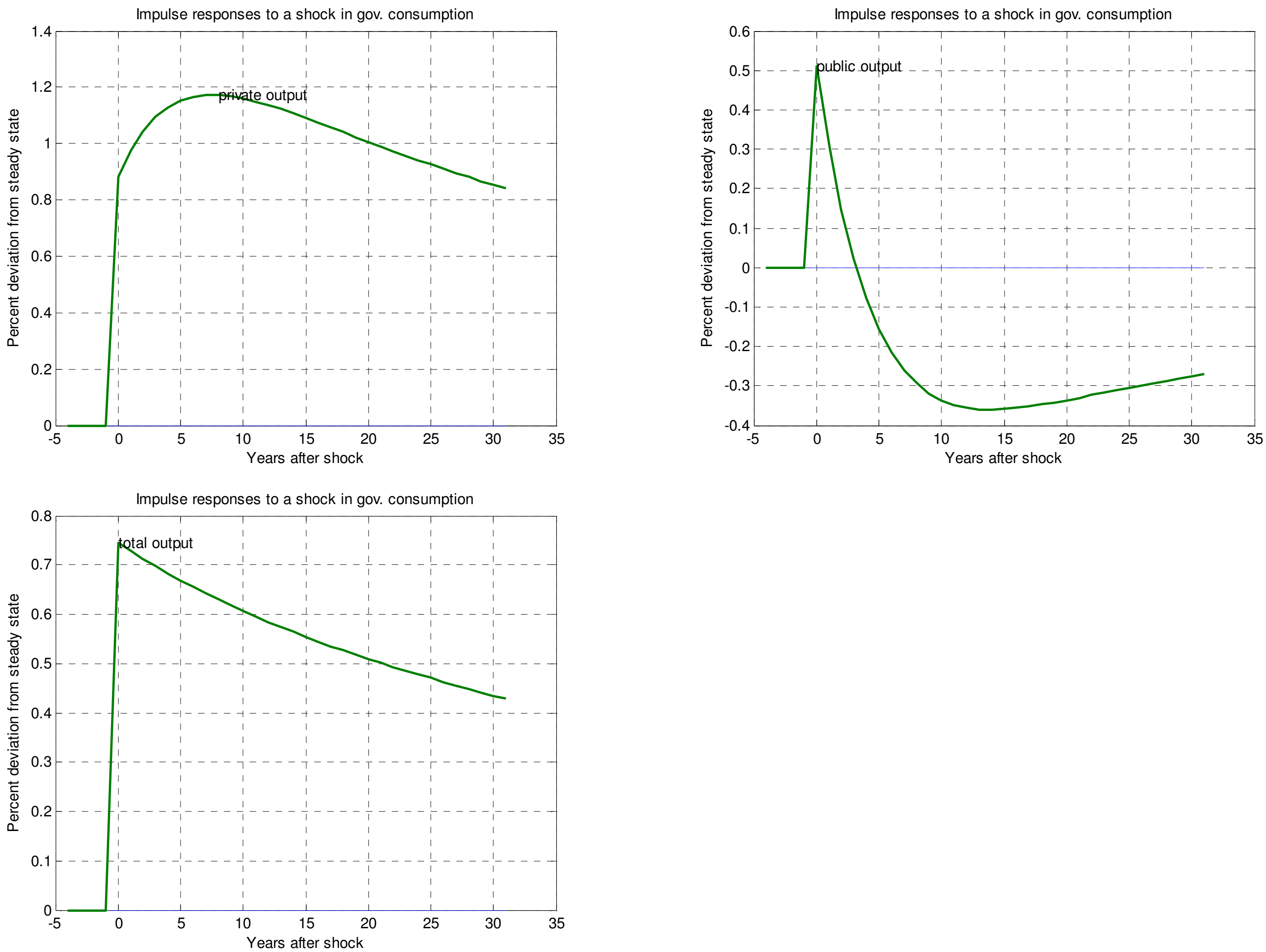


Figure 10: Effects of shocks to government expenditure (ctd).

e) Effects on consumption, wages and interest rates

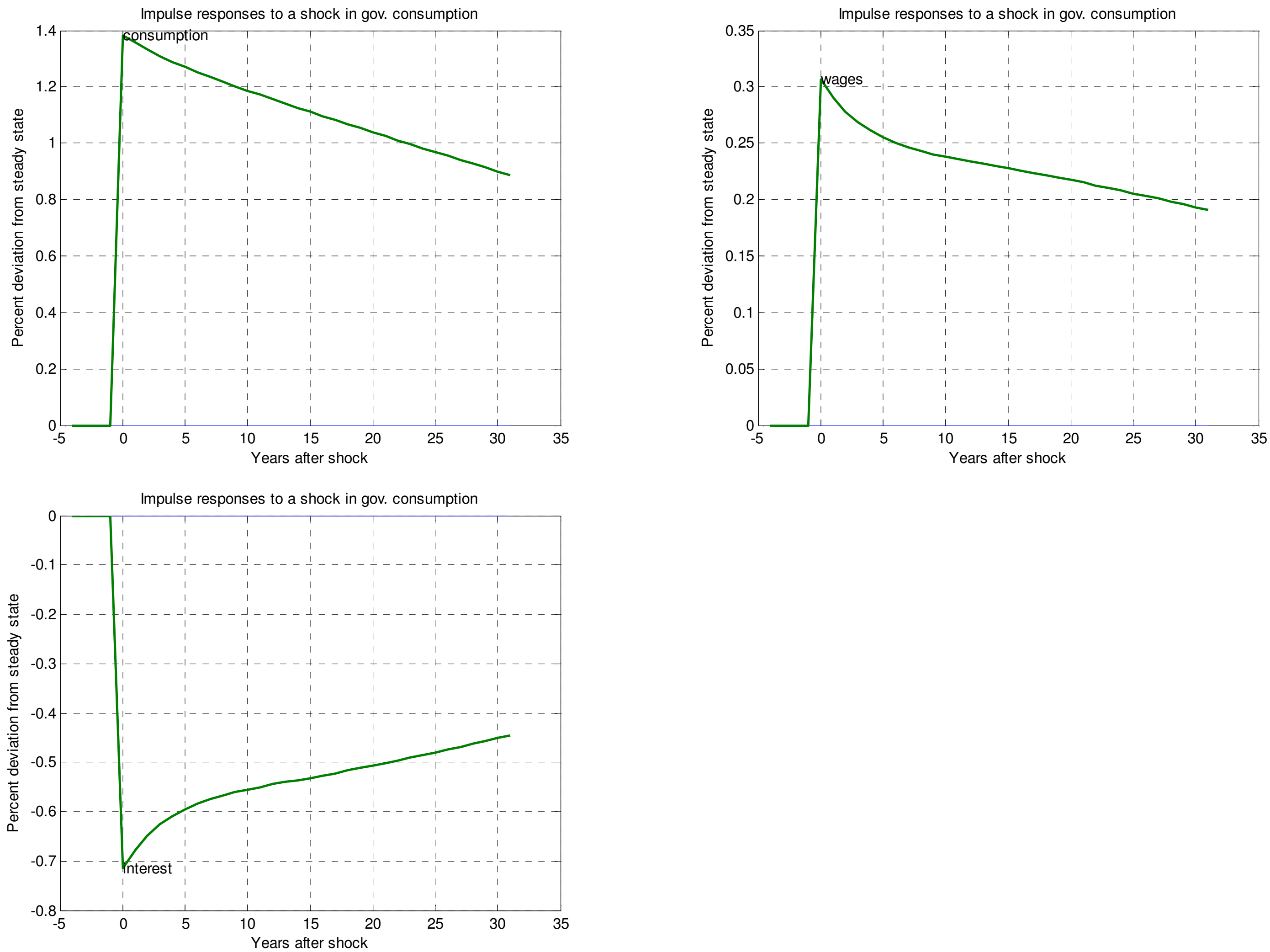


Figure 11: Effects of exogenous oil shocks, $\psi = 0.5$.

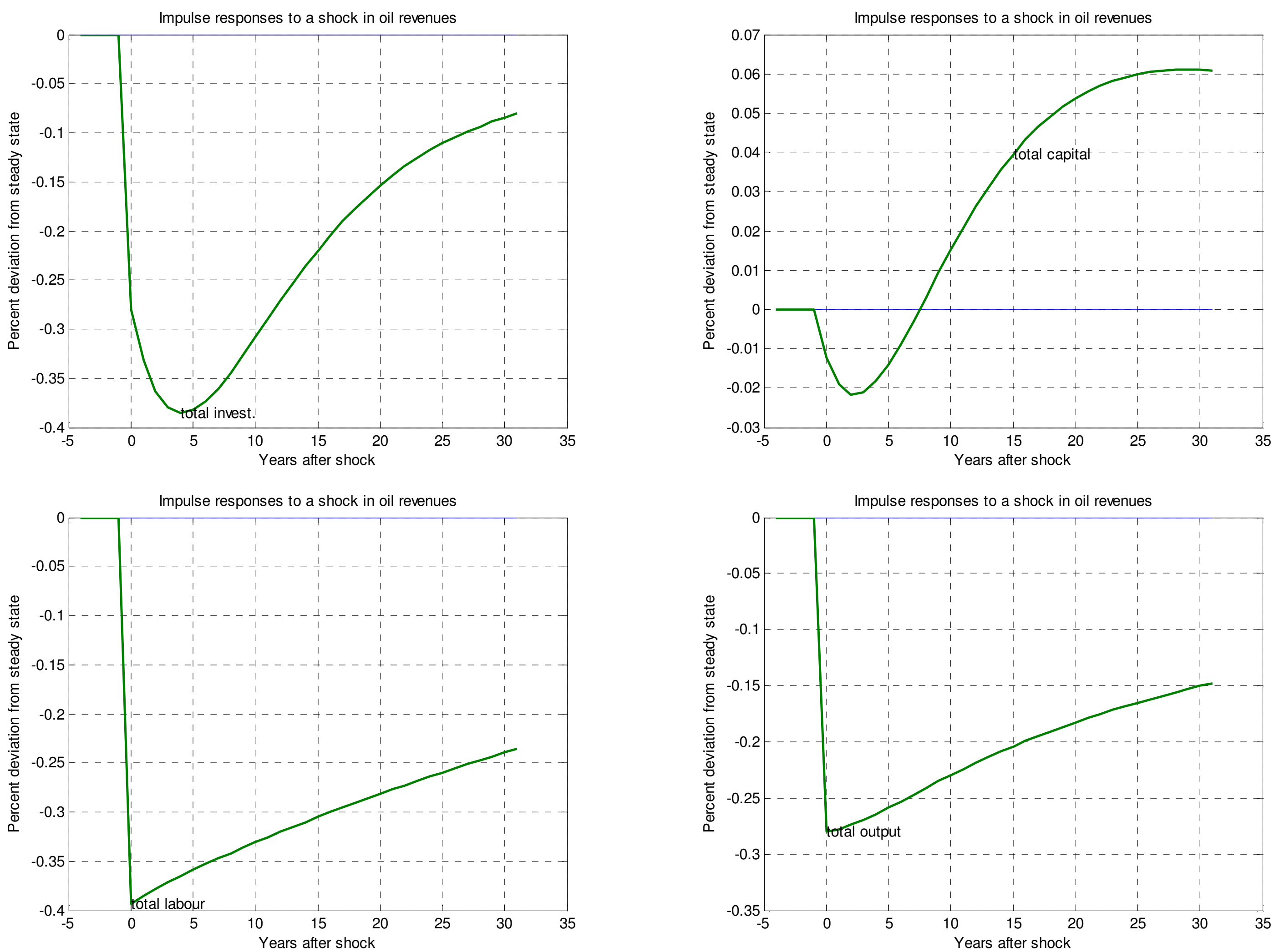


Figure 12: Effects of shocks to government expenditure, $\psi = 0.5$.

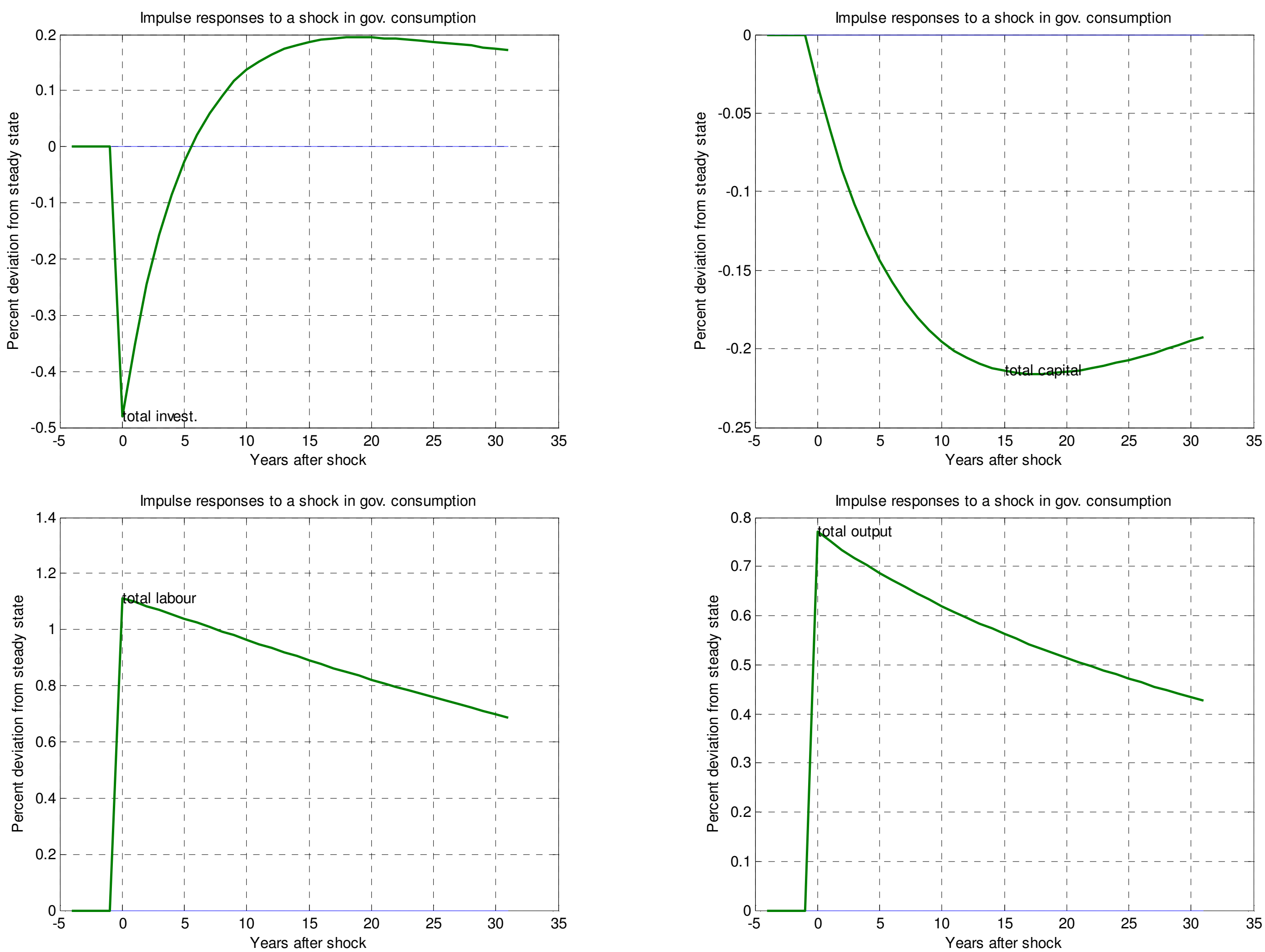


Figure 13: Effects of shocks to oil shocks, $(C + I^P)/Y = 0.51$.

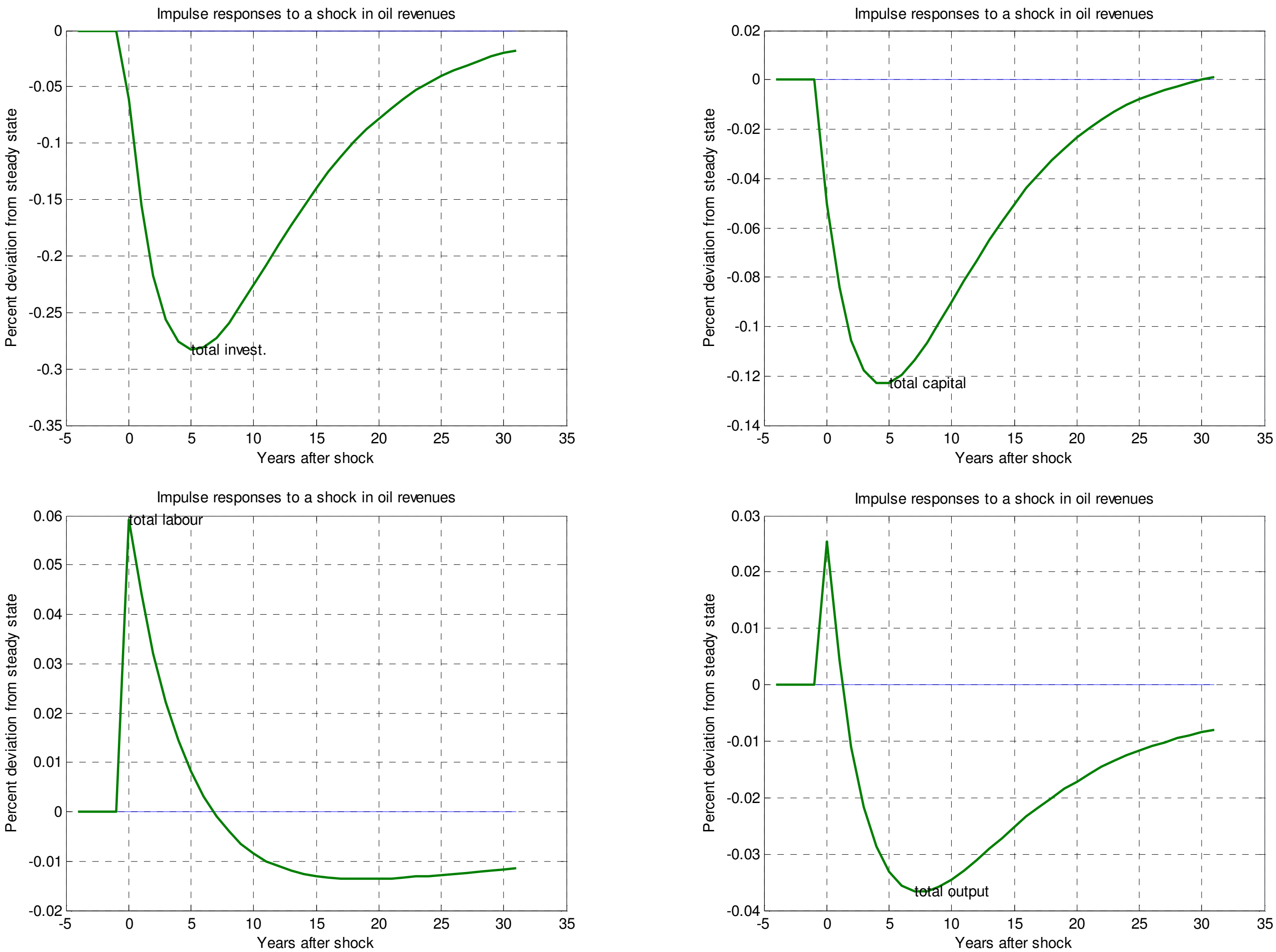
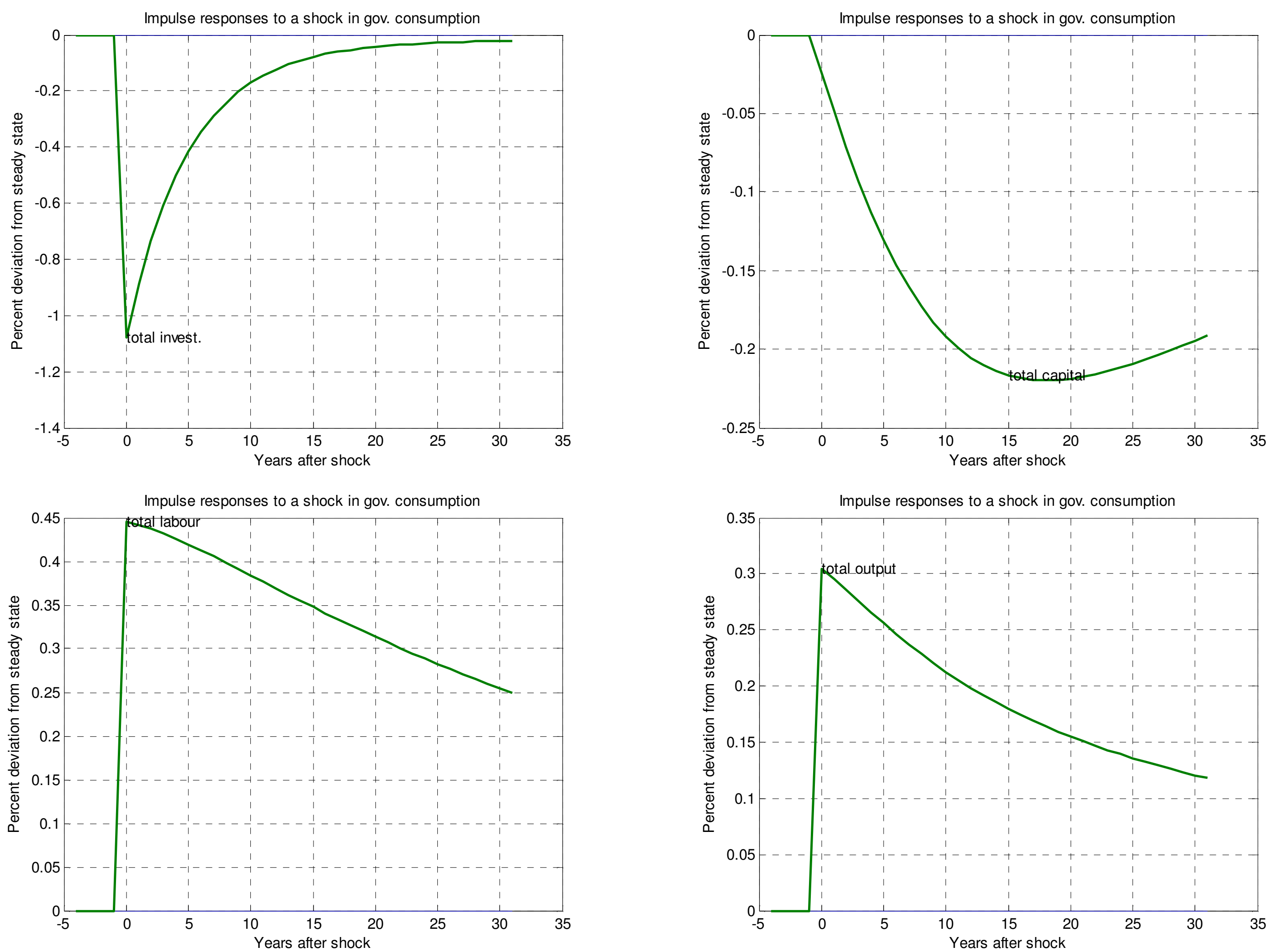


Figure 14: Effects of exogenous government expenditure, $(C + I^P)/Y = 0.51$.



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