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CONSUMPTION AND EMPLOYMENT:
THEORY AND EVIDENCE**

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INTERNATIONAL MACROECONOMICS



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ABSTRACT

The Effects of Fiscal Policy on Consumption and Employment: Theory and Evidence*

This Paper compares the dynamic impact of fiscal policy on macroeconomic variables implied by a large class of general equilibrium models with the empirical results from an identified vector autoregression. In the data we find that positive innovations in government spending are followed by strong and persistent increases in consumption and employment. The effects are particularly pronounced when government wage expenditures increase. We compare these findings to several variations of a standard real business cycle model and we find that the positive correlation in the responses of employment and consumption cannot be matched by the model under plausible assumptions for the values of the calibration parameters.

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NON-TECHNICAL SUMMARY

This Paper provides a detailed evaluation of the effects of fiscal policy on economic activity. Compared to the large empirical literature on the effects of monetary policy, fiscal policy has received much less attention. This lack of attention contrasts with recent public debates on the role of fiscal policy. The discussions around the Balanced Budget Amendment in the US, the deficit limits of the Growth and Stability Pact under EMU, or the possibility of having independent institutions running fiscal policy are all based on the assumption that fiscal policy is an effective tool for stabilizing business cycle fluctuations

We inspect the mechanisms behind the dynamic properties of a large class of general equilibrium models and compare them to the empirical results from an identified vector autoregression. In contrast to other Papers in the literature that have characterized fiscal policy by the budget balance, in this Paper we focus on the effects of changes in government spending. The primary reason for this rather restrictive focus is that alternative theories imply different economic dynamics following a change in government spending while having qualitatively similar predictions for the effects of changes in tax rates. The second reason for reporting impulse responses only to spending shocks is that it allows us to avoid the econometric modelling of the contemporaneous interaction between taxes and economic activity, which is by no means trivial.

The first thing that stands out from our empirical results is the fact that increases in government expenditures are expansionary. Moreover, the multiplier is greater than one as is obvious from the fact that private output reacts positively to the shock. This is not inconsistent with the theoretical benchmark. A permanent increase in government expenditures can lead to a more than one-to-one increase in output. What is surprising, and it is clearly at odds with the predictions of the RBC model, is the composition of that expansion. In our theoretical experiments the expansion in private output is driven by an increase in investment that more than compensates for the fall in consumption. In the estimated impulse responses, however, the reverse holds. The increase in private output is coming from an increase in consumption. It is difficult to reconcile the increase in consumption with our benchmark models. Consumption always falls because of the negative wealth effect of higher government expenditures.

A second related failure of the RBC model is its inability to replicate the response of employment. In our policy experiments, employment and consumption always move in opposite directions. In the VAR, however, both employment and consumption go up in response to an increase in government expenditures. The reason is that for employment and consumption to move in the same direction, there has to be a large change in the real wage to compensate for the fact that, if consumption and leisure are

both normal goods, they will tend to move in the same direction in response to changes in a household's wealth.

Finally, when we look at the response to changes in different components of government expenditures, we find that increases in government consumption are always expansionary, while increases in public investment do not have a significant impact on output. Here, our model cannot provide us with a proper benchmark to analyse some of these policy experiments because we have not made explicit the role of different components of government spending. In our impulse responses, however, increases in government employment (wage spending) have the largest effect on the economy, and thus seems to contradict the theoretical prediction of the literature on the effects of government employment. Regarding investment, most theoretical models have considered public capital as an input in the production function of the private sector. If this is the case, we expect a strong expansionary effect of increase in public investment. The opposite is true in our results where we show that increases in public investment have no significant effect on private output.

Overall, it is clear that the biggest failure of the benchmark theoretical model is its inability to predict the response of consumption to shocks to government expenditures. The results in the empirical section have more of a Keynesian flavour, which is not captured by a standard RBC model. The textbook Keynesian cross, or the IS–LM model, do predict a positive response of consumption to government expenditures, as a result of the strong dependence of consumption on current income. The inclusion of liquidity constraints, finite horizons or some sort of myopic behaviour by consumers could potentially explain why consumption increases when government expenditures increase. Although, in the context of the Ricardian equivalence debate, there are many Papers that have studied how finite lifetimes and liquidity constraints make government debt net wealth and therefore might increase consumption, the set-up of all these models tends to be different from that of a dynamic stochastic RBC model, as they are only concerned with steady-state effects. As a result, it is difficult to compare our dynamic impulse responses to the quantitative predictions of those models, although qualitatively, those models have features that potentially can explain the positive response of consumption observed in the data.

1.- INTRODUCTION

Compared to the large empirical literature on the effects of monetary policy, fiscal policy received much less attention in economic research until recently. This lack of attention was at odds with the fact that several key public debates on the role of fiscal policy were based on arguments eliciting the macroeconomic importance of government spending and taxation. The discussions around the Balanced Budget Amendment in the US, the deficit limits of the Growth and Stability Pact under EMU, or the possibility of having independent institutions running fiscal policy are all based on the assumption that fiscal policy is an effective tool for stabilizing business cycles fluctuations. The need for empirical evidence to elucidate the issues in these debates spurred a large body of new research, which can be loosely grouped in three categories. First, a group of economists focused on specific episodes, fiscal consolidations, to study the macroeconomic impact of large reductions in the budget deficit.¹ The second line of research analyzed the stabilizing capability of fiscal policy variables, i.e. to what extent the tax and transfer system provides insurance against idiosyncratic regional shocks and how well it stabilizes macroeconomic fluctuations in the aggregate.² Finally, the dynamic effects of discretionary fiscal policy on macroeconomic variables – a typical issue in the large macroeconometric models of the 1960s and 1970s – was recently revived within the framework of vector autoregressions in the work of Blanchard and Perotti (1999).

By investigating the effects of shifts in fiscal policy stance on economic activity, this paper contributes to the third strand of research outlined above. The goal of the paper is two-fold. First, we want to document some of the robust findings on the dynamic effects of variation in government spending on key macroeconomic variables. We believe that the reported empirical evidence will be helpful in current policy discussions. Second, we compare our empirical findings to the predictions of the real business cycle model. We use this model as a benchmark because of its popularity and more importantly because it illustrates clearly the mechanisms behind the main theoretical responses. In particular, we are inter-

¹ See for example, Giavazzi and Pagano (1990), Bertola and Drazen (1993) or Alesina and Perotti (1995).

² This category includes papers on fiscal federalism and the provision of insurance by the tax and transfer system – e.g. von Hagen (1992), Asdrubali, Sorensen and Yosha (1996) – as well as recent studies on the stabilizing role of government size as Galí (1994) and Fatás and Mihov (forthcoming).

ested in the response of consumption and employment to changes in government spending because the theoretical model has uniform qualitative predictions about the effects of fiscal policy on these two variables over a wide range of variations in the underlying assumptions. Moreover, the model consistently implies that the conditional correlation of consumption and employment must be negative – increases in government spending must increase hours worked and lead to a decline in consumption.

Focusing the analysis on the response of macroeconomic variables to an identified fiscal policy shock is a more restrictive test of the real business cycle model than the traditional methodology of matching unconditional moments to a model with a variety of shocks. As shown in Christiano and Eichenbaum (1992), some of the initial puzzles of RBC models can be resolved by the inclusion of additional sources of shocks. However, Galí (1999) argues that, even if the model can replicate the unconditional moments of the data, it may provide a distorted picture of the economy’s response to each of the shocks.

We compare our empirical results to a modification of the basic RBC model proposed by Ludvigson (1996). This model allows us to track the effects of deficit-financed spending increases in a setup with distortionary taxes, which is arguably a more realistic representation of fiscal policy than the conventional lump-sum financing or the balanced budget policy rule. Thus we report a broader range of policy experiments than one can find in the prototypical RBC model. It is interesting to note that in addition to bringing the model’s setup closer to reality, the introduction of a government sector in the RBC model has been hailed as an important improvement in model’s ability to match the data. Christiano and Eichenbaum (1992) argue that without allowing for stochastic government spending, the standard real business cycle model cannot replicate the well-documented observation that average labor productivity and hours worked are only weakly correlated. The explanatory power of government spending in this context is derived from the fact that shifts in fiscal policy lead to changes in labor supply and thus to negative correlation between hours and productivity. This negative correlation can offset the high positive comovement between productivity and hours driven by technology shocks. Indeed, we show that following an increase in government spending real wages decline while labor supply increases. The mechanism behind this negative conditional correlation is exactly the same as the one driving the negative correlation between consumption and employment – the absorption of resources by the government requires that private agents increase their work

effort and reduce their consumption. Thus, the improvement in the model's fit in the direction of matching the Dunlop - Tarshis observation of low or negative correlation between real wages and hours creates as a by-product another puzzling result, namely the negative correlation between consumption and hours, which is in stark contrast to the empirical results in this paper. We document that in the data both employment and consumption increase after an increase in government spending.

The empirical evaluation of the effects of fiscal policy is conducted using a vector autoregression framework. Some of the earlier work on fiscal policy has often relied on the cyclically-adjusted primary deficit as a measure of fiscal policy stance. Although the adjusted deficit does deliver information about current policy, it is inappropriate in dynamic macroeconometric analysis because none of the competing theories implies that spending increases and tax cuts have the same effect on the economy.³ In this paper we focus on the effects of changes in government spending. The primary reason for this rather restrictive focus is that alternative theories imply different economic dynamics following a change in government spending while having qualitatively similar predictions for the effects of changes in tax rates. Furthermore, our focus on the conditional correlation of consumption and employment requires that we identify only spending shocks.⁴

One generic issue with fiscal policy VARs is the fact that both revenue and expenditure adjustments are often pre-announced. While in the case of monetary policy there is a certain logic in focusing on unanticipated changes in policy stance, it is difficult to mechanically extend this logic to fiscal policy. Moreover, if pre-announced changes in policy stance do not vary systematically with general macroeconomic conditions, the VAR will be omitting important information and will be misspecified by not including anticipated changes in expenditure or revenue variables. We address this criticism in a sequence of robustness exercises that

³ See Blanchard and Perotti (1999). We illustrate this argument by tracing output responses after a deficit-financed tax cut and a deficit-financed spending increase in a dynamic general equilibrium model. The fact that impulse responses differ suggests separating spending and tax variables in the VAR and requires modeling the contemporaneous relationship between fiscal and general macroeconomic variables.

⁴ In a paper with related empirical focus, Blanchard and Perotti (1999) analyze the responses of real GDP and components of output to a fiscal policy shock. The difference is in the specification of the benchmark VAR and in the identification. Succinctly, we leave tax shocks unidentified because their effects are not studied in this paper, while Blanchard and Perotti (1999) estimate tax elasticities in order to separate the autonomous shifts in average tax rates from the endogenous responses of taxes to the state of the economy.

use official budget forecasts to augment the information set in the VAR thus accounting, at least partially, for anticipated fiscal policy.⁵

Our results show that increases in government spending are expansionary with a multiplier larger than one, i.e. output increases more than one-to-one. When we compare our results to a standard RBC model we find that the largest discrepancy between the model and the empirical results is the response of consumption. In the empirical estimations, the expansion in output is always accompanied by an increase in consumption. Although an RBC model can produce an expansion in output following an increase in government expenditures, as in Baxter and King (1993), consumption always decreases in response to an expansion in government spending because of the obvious negative wealth effects. The model also fails to capture the positive correlation between the empirical response of employment and consumption following an increase in government spending.

The next section describes the econometric framework and reports results from a battery of VARs. Section 3 presents the benchmark general equilibrium model. Policy simulations based on this model are reported in Section 4. Section 5 compares the dynamics derived from the theoretical model to the empirical impulse responses from the VARs. The last section provides some concluding remarks.

2.- EMPIRICAL RESULTS

Throughout this section we use data from the NIPA files at quarterly frequency and the averaged quarterly 3-month T-bill rate. We also use data on wages and CPI from the Bureau of Labor Statistics.⁶ We consider this vector of endogenous variables as the minimal set of macroeconomic variables necessary for the study of the dynamic effects of fiscal policy changes. We also study the effects of alternative components of spending on the economy as well as the dynamics of output components after a fiscal policy innovation. In these cases we augment the vector of endogenous variables in the VAR as required.

⁵ An alternative to the VAR approach is advocated by Edelberg, Eichenbaum and Fisher (1998) and Burnside, Eichenbaum and Fisher (1999). They argue against using VAR-based innovations in fiscal variables as measures of policy shifts and propose a study based on including dummies for three episodes of military build-ups.

⁶ All variables are in logs except for the interest rate. The data sources are: The University of Virginia NIPA files and the Federal Reserve of St. Louis database, FRED. Based on the Akaike information criterion we select 4 lags (values from 1 to 12 have been tried for the lag length).

Blanchard and Perotti (1999) provide a careful analysis of the identification issues in a similar setup, arguing in particular that there are no institutional reasons to believe that any of the spending components reacts automatically to changes in economic conditions. With respect to the reaction of taxes to innovations in output, they construct the appropriate elasticity by calculating the responsiveness of specific tax components to output fluctuations. In this paper we adopt the identification with respect to spending, but we leave the contemporaneous relationship between macroeconomic and tax variables unrestricted in the tradition of the semi-structural VAR literature.⁷ The reason for this modeling choice is that we would like to confront alternative theories by comparing the predicted responses to changes in government spending.

Our framework is summarized by the following equations:

$$Y_t = \sum_{i=0}^k B_{1,i} Y_{t-i} + \sum_{i=0}^k B_{2,i} P_{t-i} + \sum_{i=1}^k C_{1,i} E_{t-i}[P_t] + \sum_{i=1}^k C_{2,i} E_t[P_{t+i}] + A^y v_t^y \quad (1)$$

$$P_t = \sum_{i=0}^k D_{1,i} Y_{t-i} + \sum_{i=0}^k D_{2,i} P_{t-i} + \sum_{i=1}^k H_{1,i} E_{t-i}[P_t] + \sum_{i=1}^k H_{2,i} E_t[P_{t+i}] + A^p v_t^p \quad (2)$$

Vector Y represents the set of macroeconomic variables necessary for estimating the induced changes in the budget variables and sufficient for the description of the dynamic properties of the economy. P is a vector of fiscal policy variables and in our case this will normally include net taxes and a measure of spending. In addition to these variables we include on the right-hand side private and official projections of revenue and expenditure variables. The fact that forecasts enter with k lags, as the other variables, is not restrictive or demanding since we can impose that some of the coefficient matrices are zero. Following Blanchard and Perotti (1999) we will take government spending variables as predetermined with respect to macroeconomic shocks and unanticipated changes in taxes. In other words, changes in government investment, wage or non-wage spending are undertaken for reasons other than immediate reaction to macroeconomic conditions. Also, this assumption amounts to arguing that tax rate decisions are taken only after spending is determined. This is a plausible, but unfortunately untestable hypothesis. One argument in favor of this assumption is that tax changes are

⁷ See Bernanke and Blinder (1992) and Bernanke and Mihov (1998) for an application of semi-structural VARs to the study of monetary policy.

decided on a yearly basis and are largely pre-announced. Hence, they should be properly captured by the expectations variables on the right-hand side. In case there is an unanticipated tax cut or hike, our assumption implies that this change has deficit implications, but does not induce immediate spending adjustments.

Responses to Changes in Government Spending

To illustrate the macroeconomic effects of changes in government spending we first use the baseline VAR and we exclude the forecast of the budget.⁸ Hence the vector of endogenous variables consists of $(G_t, GDP_t, PGDP_t, Tax_t, Rbill_t)$. Figure 1 shows the responses of the endogenous variables to a one standard deviation shock to real government spending. The impulse responses are reported for a horizon of ten years with one-standard deviation error bands calculated with Monte Carlo integration methods with 500 replications.

There is a strong and persistent reaction of private output to a fiscal shock. The maximum effect of an approximately 1% increase in spending is attained about two years after the shock with private output increasing by 0.3%. The spending shock itself is very persistent with a half-life of about five years. On the revenue side, the short-run dynamics of net taxes differ substantially from the evolution of expenditures. Tax revenues reach the level of spending only with a lag of five to six quarters. The adjustment to trend after the initial two years for both fiscal variables is quite similar. The GDP deflator declines slightly, but overall the point estimate of the impulse response is not far away from trend. Finally, the real 3-month T-bill rate increases on impact and then returns to trend after four quarters.

The first pass on the economic effects of fiscal policy is in some sense consistent with a large variety of economic theories, including Keynesian, Neo-Keynesian, real business cycle theories or models with increasing returns, as all of these theories predict that increases in government spending have an expansionary effect on economic activity with raising output and real interest rates. To have a better sense of what changes fiscal policy induces in the economy we now look closer at the responses of: (a) consumption and investment and their components, and (b) labor market variables. To this end we augment our baseline VAR to include the variable, which we want to analyze. We start first with the components of GDP, thus augmenting the vector of variables to $(G_t, X_t, GDP_t,$

⁸ This is equivalent to setting $C_{1,i} = C_{2,i} = H_{1,i} = H_{2,i} = 0, \forall i$.

$PGDP_t$, Tax_t , $Rbill_t$), where X_t is either a consumption or an investment component. Figure 2 displays the responses. A key finding is that the increase in government spending is followed by a persistent rise in all components of consumption. This increase to a large extent fuels the rise in private output. At the same time investment does also increase, but only with a lag of six quarters and after three years returns to trend. The basic force behind the increase in investment is the increase in residential investment, while nonresidential investment declines slightly.

Next we turn to the responses of labor market variables, replacing now X_t with a measure of wages, hours, or employment. Figure 3 indicates that wages increase in manufacturing and construction, but the overall wage level hardly changes. Burnside, Eichenbaum, and Fisher (1999) have emphasized the fact that the reaction of wages is not very robust to alternative specifications of the wage variable and to alternative deflation methods. Yet, our result for manufacturing wages seems to be quite robust across specifications and definitions and conforms with the findings of Rotemberg and Woodford (1992). Similarly, the response of manufacturing hours is quite pronounced, while total private hours do not deviate significantly from trend line. Importantly, however, employment increases for the whole economy, with manufacturing employment reacting particularly strongly. This dynamics of total employment is consistent with the standard real business cycle model, as we illustrate below.

The set of impulse responses on Figures 1, 2 and 3 provides an important test for contemporary theories of business cycles. First and foremost, an increase in spending leads to a persistent rise in private output, with consumption and residential investment being the driving factors. Second, the expansionary fiscal policy is also associated with rising manufacturing wages and increasing total private employment. Finally, the response of the real interest rate is always positive and significant.

Robustness

We check the robustness of our results to the inclusion of policy forecasts in the VAR. As argued in the introduction, changes in tax schedules are often pre-announced. Second, a forecast of government spending for the following fiscal year is readily available from the fiscal authorities long before the fiscal year starts. Under these conditions, there is a serious concern whether the results in this paper are in fact reporting responses to exogenous changes in fiscal policy,

or endogenous dynamics in the economy. To address this issue we performed two tests. First, we collected data from the Economic Report of the President (various years) on the forecast of budget outlays for the following fiscal year. There are two reasons why this forecast might enter the VAR significantly. First, it is possible that the dynamic structure is not capturing well enough the evolution of government spending because of non-linearities, for example. This will create a problem, since some part of the spending variable might appear as unanticipated even though it was included in the forecast one or two years before its realization. This implies that we should include past expectations of current policy variables. And indeed this is why in the general specification of equations 1 and 2 we include past forecasts of the current policy variable. This is captured now by relaxing the assumption that $C_{1,i} = H_{1,i} = 0, \forall i$. Next, the budget for the following fiscal year becomes known well in advance. In models with forward-looking behavior one can prove that under standard parameterization households will change their consumption and leisure choices as soon as future spending plans by the government are revealed. This means that we should include in the information set all budgetary forecasts for future spending variables, known at time t . This is modeled by allowing for current expectations of future policy variables to enter the VAR.

The empirical estimation uses projections of federal expenditures reported in the beginning of the current year for the following fiscal year. Since the data is annual we have simply entered the same value for each quarter. The particular specification that we have estimated uses both the past forecasts of current variables as well as current forecasts of future variables. We have restricted the system, so that only the forecast from the previous two fiscal years and the following fiscal year enter the regression. Although we observe increase in the error bands, there is no change in the qualitative dynamics following an unanticipated increase in government spending.

Another direction in which we investigate the sensitivity of our results is to trace the dynamics of macroeconomic variables after a shock to one of the components of government spending. Most notably Baxter and King (1993) argue that an increase in government investment has a much stronger impact on the economy than a pure rise in government purchases of goods and services. And indeed, by creating different incentives the three main expenditure components, government investment, wage spending, and non-wage spending, should exert different impacts on macroeconomic variables. We replace aggregate government spending

sequentially with one of the three components, while preserving in the specification real net taxes, real interest rate, and the GDP deflator. In the place of real private output we include simultaneously investment and consumption, thus transforming the vector of endogenous variables to: $(Gx_t, C_t, I_t, PGDP_t, Tax_t, Rbill_t)$, where Gx_t is one component of government spending. The new VAR contains six variables with a basic identification that the government spending variables are ordered first, while the contemporaneous relationship among the rest of the variables is left unspecified. Our main finding is that in all cases consumption goes up following a fiscal shock, but the most pronounced rise in private consumption occurs when government wage expenditures increase.⁹

3.- A BENCHMARK

In this section we write down and calibrate a standard RBC model that will serve as a benchmark in the comparison of our empirical results to the theoretical predictions of general equilibrium models. The model is very close to the models in Baxter and King (1993), Campbell (1994), and Finn (1998) with one very important modification: We do allow for debt-financed tax cuts and government spending increases as in Ludvigson (1996). Compared to the latter paper, the current one extends the research in this area by reporting the dynamic evolution of key macroeconomic variables, while Ludvigson (1996) calculates only partial elasticities.

The production function is Cobb-Douglas

$$Y_t = (A_t N_t)^\alpha K_t^{1-\alpha}$$

where Y , N and K denote output, labor and capital and A_t is a technological parameter.

Capital accumulates following

$$K_{t+1} = (1 - \delta)K_t + Y_t - C_t - G_t$$

where C and G represent consumption and government expenditures and δ is the depreciation rate.

⁹ All robustness results are available upon request.

A representative consumer maximizes the following utility function

$$E_t \sum_{s=0}^{\infty} U(C_{t+s}, 1 - N_{t+s})$$

where

$$U(C_t, 1 - N_t) = \log(C_t) + \theta \frac{(1 - N_t)^{1-\gamma}}{1 - \gamma}$$

subject to

$$C_t + K_{t+1} + D_{t+1} = (1 - \delta)K_t + R_{t+1}^g D_t + (1 - \tau_t)Y_t$$

and where D_t represents government debt holdings that pay a gross return equal to R_{t+1}^g and τ_t is the tax rate. The dynamics of government debt follow

$$D_{t+1} = R_{t+1}^g D_t + G_t - \tau_t Y_t$$

We denote by R_{t+1} the gross marginal product of capital, which is

$$R_{t+1} \equiv (1 - \tau_{t+1})(1 - \alpha) \left(\frac{A_t N_{t+1}}{K_{t+1}} \right)^\alpha + (1 - \delta)$$

The solution of the above model leads to the following first-order conditions for consumption

$$1/C_t = \beta E_t [R_{t+1}/C_{t+1}] = \beta E_t [R_{t+1}^g/C_{t+1}]$$

and a static first-order condition for leisure

$$\theta(1 - N_t)^{-\gamma} = (1 - \tau_t) \alpha \frac{A_t^\alpha}{C_t} \left(\frac{K_t}{N_t} \right)^{1-\alpha}$$

In the absence of shocks, this economy will follow a balanced growth path given by technological progress.¹⁰ Along the balanced growth path capital, consumption, output, and government debt grow at the same rate.¹¹

¹⁰ We assume that technological progress is constant and equal to $1 + \mu = A_{t+1}/A_t$.

¹¹ Using the first order condition for consumption, then $1 + \mu = \beta R$ where R is the gross rate of return on capital along this path.

To solve the model we follow Campbell (1994) and approximate the system of non-linear equations by log-linearization. The resulting system can be solved by the method of undetermined coefficients. The solution expresses all variables in terms of the state variables and the forcing exogenous processes. To sharpen our discussion of fiscal policy changes we assume that technology does not deviate from its balanced growth path, thus leaving government spending and debt issue as the only exogenous forces in the system.

We assume that both log government expenditure and log government debt follow a first-order autoregressive process (measured as deviations from a steady state). The tax rate will adjust to make sure that the government budget constraint is satisfied.

$$g_t = \rho g_{t-1} + \epsilon_t$$

$$d_t = \phi d_{t-1} + u_{t-1}$$

Given these stochastic processes, we can solve the model in terms of k_t , g_t , d_t and u_t . Notice that for a given g_t , d_t and u_t (all known at time t) the expected value for future fiscal policy variables (taxes, government expenditures and debt) is well defined. The solution to the linearized model will be a set of log-linear equations where each of the endogenous variables (c_t , k_{t+1} , n_t , and y_t) will be a function of the four state variables (k_t , g_t , d_t and u_t).

4.- RESPONSES TO SHOCKS

The specification of fiscal policy in the equations above allows us to look at the effects of fiscal policy shocks under different assumptions regarding both the distortionary nature of taxes and the way deficits are financed. To isolate different incentive effects of fiscal policy we analyze both lump-sum and distortionary taxation. Moreover, by looking at distortionary taxes, we are able to study the effects of different forms of financing government expenditures. The fact that taxes are distortionary implies that the Ricardian equivalence may not hold and therefore the timing of taxes might matter.¹² To illustrate this conjecture we look

¹² Both Baxter and King (1993) and Finn (1998) have models with government debt and distortionary taxes, but in their setup the Ricardian equivalence holds because they allow the government to close the deficit by imposing lump-sum taxes. As long as the taxing authority does not have access to lump-sum taxes, the Ricardian equivalence fails under a broad set of assumptions.

at the response of the economy to deficit-financed and tax-financed increases in government expenditures.

There are four policy experiments discussed in this section. First we consider an increase in government spending financed fully by a lump-sum tax. This experiment illustrates one of the basic channels through which fiscal policy affects economic activity in general equilibrium models. The next policy experiment again imposes a balanced budget constraint but requires that expenditures are financed by distortionary taxes. In terms of the model outlined above these two exercises require that the debt-to-GDP ratio is zero, there are no shocks to debt, i.e. u_t is zero, and the shock is a one unit increase in ϵ_t . The third set of exercises introduces debt by asking the question what happens after a tax cut which is not matched by a reduction in spending but instead is fully financed by a new debt issue. In this case ϵ_t is held at zero, while u_t is increased by one unit. Finally, a deficit-financed spending increase requires that ϵ_t be increased by one unit, i.e. there is an increase in government expenditures, while debt is increased by the amount necessary to keep taxes constant in the initial period.¹³

Lump-sum taxation

In this section we consider innovations to government spending (g) that are financed by lump-sum taxation, and consequently we let $\tau_t = 0$. The effects of government spending on economic activity derive from the fact that the government absorbs resources and thus has a negative effect on the representative agent's private wealth. Under these assumptions, Ricardian equivalence holds and, therefore, the timing of taxes does not matter at all. We experiment with different values of the elasticity of labor supply (σ_n) because the effects on output and investment are radically different. For the sake of space we only report in Figure 4 the extreme cases of inelastic labor supply ($\sigma_n = 0$) and perfectly elastic labor supply ($\sigma_n = \infty$). The increase in government spending results in a decrease in the wealth of the consumers, which in turn leads to a decrease in consumption and an increase in the labor effort. The larger the elasticity of labor, the bigger the response of labor supply. The increase in N leads to an increase in output

¹³ For all our calibrations below, we follow Ludvigson (1996) and we set (quarterly rates) the growth of technology (μ) equal to 0.005, $G/Y = 0.2$, $D/Y = 2.2$, $\alpha = 0.667$, $\delta = 0.025$ and $r = 0.015$. These values imply $\tau = 0.222$ in steady state. The persistence parameters for the stochastic processes of g and d are both set equal to 0.95 (ϕ and ρ). The steady state value of N is set equal to 1/3. For some of the other parameters (e.g. σ_n , the elasticity of labor supply) we experiment with different values in the policy experiments below.

(larger for high values of σ_n). The response of investment depends on the marginal product of capital. When employment changes very little, the marginal product of capital remains practically constant and the increase in the rate of return is not sufficient to induce the representative household to save more which in turn leads to lower investment. As the response of labor increases, the positive effect on the marginal product of capital becomes larger and at some point households, although they are faced with a decline in their wealth, prefer to cut consumption even further and increase saving because the rate of return is very high. After a certain value of the elasticity of labor supply, the response of investment becomes positive, which leads to a very pronounced response of output.

Distortionary taxes

With distortionary taxes we have to take into account the financing of the increase in government expenditures. We first look at the case where taxes increase in parallel to government expenditures so that there is no change in public debt. Figure 5 displays the responses of the economy in this case. Regardless of the value of the elasticity of labor supply, consumption falls. The short-term response of labor is also negative, which means that output will also fall on impact. The effects on investment are now driven by both the distortion in after-tax rate of return and the fall in the marginal product of capital associated to the decrease in N . In all cases, investment falls which implies a further fall in output in the following quarters. In summary, in our calibrations, expansion in government spending financed with distortionary taxes is always contractionary.

Deficit-financed tax cut

We turn now to the case of a tax cut, which will help us to better understand the effects of taxes on economic activity independently of the effect of government spending described above. In this case, we keep g_t constant and we shock d_t to simulate a decrease in taxes. As before, future values of d_t and τ_t will be implied by the response of the economy and the dynamic process assumed for d_t . Figure 6 summarizes the responses of the relevant variables. With inelastic labor supply, output is constant on the first period but increases afterwards because of investment. There is a large increase in investment and an associated fall in consumption (in response to the increase in the interest rate). As labor supply becomes elastic, the response of labor supply makes this pattern even more pronounced.

Deficit-financed spending increase

Figure 7 presents the responses when the increase in expenditures is financed via a deficit. The way we have built our calibrations for this policy experiment is by assuming values for the shocks ϵ_t and u_t such that taxes do not change in impact. Given these shocks and the values for ϕ and ρ , taxes will change in the future as a result of changes in g_t and d_t that are entirely driven by the processes assumed for each of these variables. In the case where labor supply is inelastic, the impact effect on output is zero but, in the following quarters, output falls because of the fall in investment. This fall is partly caused by the increase in future taxes associated with the particular exercise we are running.¹⁴

The response of output changes significantly as we increase the elasticity of labor supply. The reason is that the increase in the supply of labor will have a positive effect on output. More importantly, as we saw in the case of lump-sum taxation, the increase in employment increases the marginal product of capital creating additional incentives for investment. Lastly, there is a third effect that pushes the economy in the same direction. Given our specification of d and g , and because output is increasing, this particular debt-financing experiment implies a cut in taxes (to make compatible the evolution of d and g). This reduction in taxes increases investment and output, as we discussed in the previous section.

What we learn from this policy experiment is that the effects of deficit-financed shocks are very different from those of tax-financed shocks. While expansion in government spending financed with distortionary taxes is contractionary, deficit-financed increases in government spending can be expansionary for high-enough values of labor supply elasticity.

In summary, the above calibrations have produced the following insights. With elastic labor supply expansion in government spending is contractionary (in terms of output) when taxes are distortionary but it can be expansionary either with lump-sum taxes or when expenditures are financed with new debt. Importantly, in all cases consumption falls in response to an increase in government spending. This is true regardless of how expenditures are financed. Investment might increase or decrease depending on several factors such as the change in

¹⁴ As mentioned above, these dynamics are the result of the stochastic processes assumed for d and g . Given the implied changes in d and g , and the general response of the other variables (e.g a fall in output) we require an increase in the tax rate τ . Clearly, there are many policy experiments that can be run by assuming different values for the parameters ϕ and ρ , but the economic intuition behind each of these scenarios will be unchanged.

employment (a function of the elasticity of labor supply), the change in the interest rate (a function of the elasticity of intertemporal substitution) and intertemporal distortions introduced by taxes. Finally, the real wage falls in most cases except in the case of tax-financed spending increases with relatively high labor supply elasticity.¹⁵

5.- THE MODEL AND THE EMPIRICAL RESULTS

In this section we analyze the empirical results of Section 2 in light of the predictions of our benchmark model. A difficulty in comparing the theoretical predictions and the empirical results is that we cannot do a perfect match of the VAR impulse responses with one of the policy experiments. To be able to do this match, we would need to isolate in the data one of the theoretical experiments. Given that the empirical response of taxes to increases in government spending is clearly less than one to one, we will focus our attention on the theoretical exercise where we looked at deficit-financed increase in government expenditures.

The first thing that stands out from our empirical results is the fact that increases in government expenditures are expansionary. Moreover, the multiplier is greater than one as it is obvious from the fact that private output reacts positively to the shock. This is not inconsistent with the theoretical benchmark. As Baxter and King (1993) argue, a permanent increase in government expenditures can lead to a more than one-to-one increase in output. This is also what the policy experiments of Section 4 show.

What is surprising, and it is clearly at odds with the predictions of the RBC model, is the composition of that expansion. In our theoretical experiments, as well as in Baxter and King (1993), the expansion in private output is driven by an increase in investment that more than compensates the fall in consumption. However, in the estimated impulse responses, the reverse holds. The increase in private output is coming from an increase in consumption. It is difficult to reconcile the increase in consumption with our benchmark models. As shown in Section 4, in none of the experiments expansionary fiscal shock leads to an increase in consumption. Consumption always falls because of the negative wealth effect of higher government expenditures.

¹⁵ We have also looked at the response to changes in different components of government expenditures. We find that increases in government consumption or government employment are always expansionary, while increases in public investment do not have a significant impact on output.

A second related failure of the RBC model is its inability to replicate the positive conditional correlation between employment and consumption. In our policy experiments, employment and consumption always move in opposite direction. In the VAR, however, both employment and consumption go up in response to an increase in government expenditures. The reason is that for employment and consumption to move in the same direction, there has to be a large change in the real wage to compensate for the fact that, if consumption and leisure are both normal goods, they will tend to move in the same direction in response to changes in household's wealth.¹⁶

In our empirical estimates the response of investment to increases in government expenditures is ambiguous. In most of the cases the response is not significant and the point estimates differ across different investment components. Although some of the components of investment, namely residential, respond positively, this increase is small and not significant. Moreover, some of the other investment components (nonresidential investment) fall in response to the increase in government expenditures. The model does not have unambiguous predictions either. Depending on the elasticity of labor supply, the response of investment can be positive or negative. A recent empirical study by Alesina, Ardagna, Perotti and Schiantarelli (1999) shows that in a panel of OECD countries, there is a negative effect of government expenditures on investment. This negative effect is mainly associated to increases in wage government consumption. Although some of our point estimates are not too far from theirs, we do not find such a strong evidence of crowding out effects of government wage consumption on non-residential investment. One possible explanation is that the justification used by the above authors applies better to OECD countries other than the US. They argue that the increase in government wage spending leads to increases in wages in the private sector that have negative impact on profits and investment. One would expect that some of these spillover effects are more important in European countries than in the US. More research needs to be done to clarify this question.

Overall, is clear that the biggest challenge to the theoretical model of Section 3 is its inability to predict the response of consumption to shocks to government expenditures. The results in the empirical section have more of a Keynesian flavor not captured by a standard RBC model. The textbook Keynesian cross or the

¹⁶ There are several papers that have highlighted the difficulties of RBC models to account for the positive correlation between employment and consumption. See, for example, Mankiw, Rotemberg, and Summers (1985) or Rotemberg and Woodford (1996).

IS-LM model do imply a positive response of consumption to government expenditures as a result of the strong dependence of consumption on current income. The inclusion of liquidity constraints, finite horizons or some sort of myopic behavior by consumers in a model such as the one in Section 3, could potentially explain why consumption increases when government expenditures increase. In the context of the Ricardian equivalence debate there are many papers that have studied how finite lifetimes and liquidity constraints make government debt net wealth and therefore in this models increases in government spending may increase consumption. The setup of these models, however, tends to be different from that of a dynamic stochastic RBC model, as they are only concerned with steady-state effects or focus only on idiosyncratic uncertainty.¹⁷ As a result, it is difficult to compare our dynamic impulse responses to the quantitative predictions of those models, although qualitatively, they have features that will explain the positive response of consumption observed in the data.

There are also models that have explored how the introduction of imperfect competition changes the response of the economy to fiscal policy shocks. Rotemberg and Woodford (1992) show how the response of real wages and output are affected by the introduction of imperfect competition. The effects present in their model are due to the increasing returns to scale and the fact that mark-ups vary over the business cycle. These changes, however, will have no effect on the response of consumption as the negative wealth effect of an increase in government spending will still reduce consumption.

6.- CONCLUSIONS

In this paper we provide an empirical analysis of the macroeconomic effects of fiscal policy. We present evidence on the responses of key macroeconomic variables to changes in government spending. We compare these responses to a standard real business cycle model to shed light on the mechanisms that determine the dynamics in a stochastic general equilibrium macroeconomic model. We find that in the data increases in government spending are expansionary with a multiplier larger than one, i.e. output increases more than one-to-one. This increase is largely driven by increases in private consumption. Investment does not react significantly to increases in government spending.

¹⁷ See Gertler (1997), Blanchard (1985) or Weil (1989).

When we compare our results to a standard RBC model we find that there are several dimensions where the model fails to fit the data. The largest discrepancy between the model and the empirical results is the response of consumption. In all policy experiments that we run on our model, consumption always decreases in response to an expansion in government spending because of the obvious negative wealth effects. This is not supported by the data. A second failure of the model is that in response to increases in government expenditures employment reacts positively, and therefore in the same direction as consumption. In the theoretical model consumption and employment move in opposite directions. The positive conditional correlation between employment and consumption observed in the data suggests that yet another modification of RBC model is required if one wants to bring the model closer to reality. Extensions of the model that build-in non-trivial failures of the Ricardian equivalence may produce promising results in bringing theory closer to reality.

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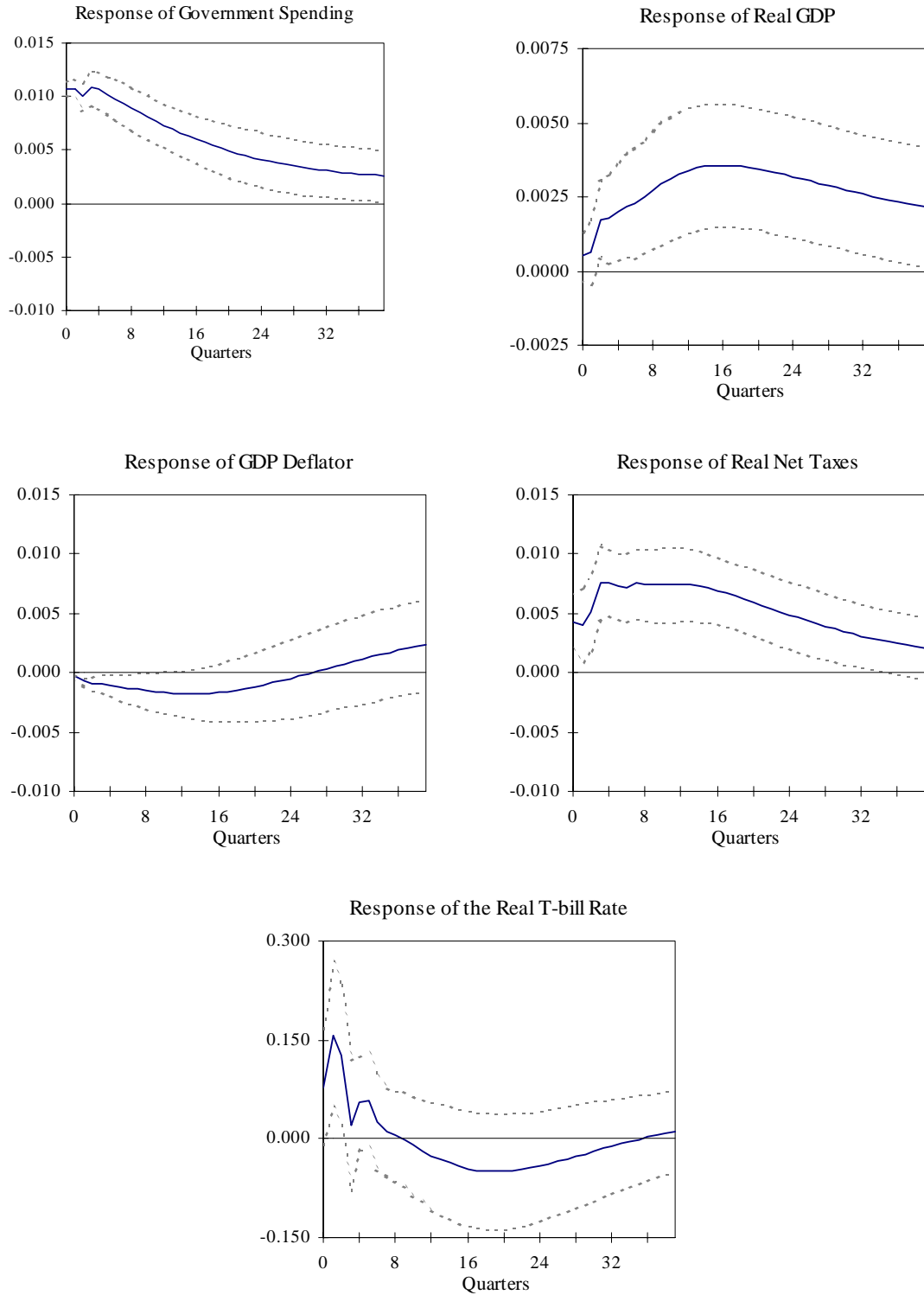


FIGURE 1
 Responses to an increase in government spending
 (Quarterly VAR, 1960:1 - 1996:4)

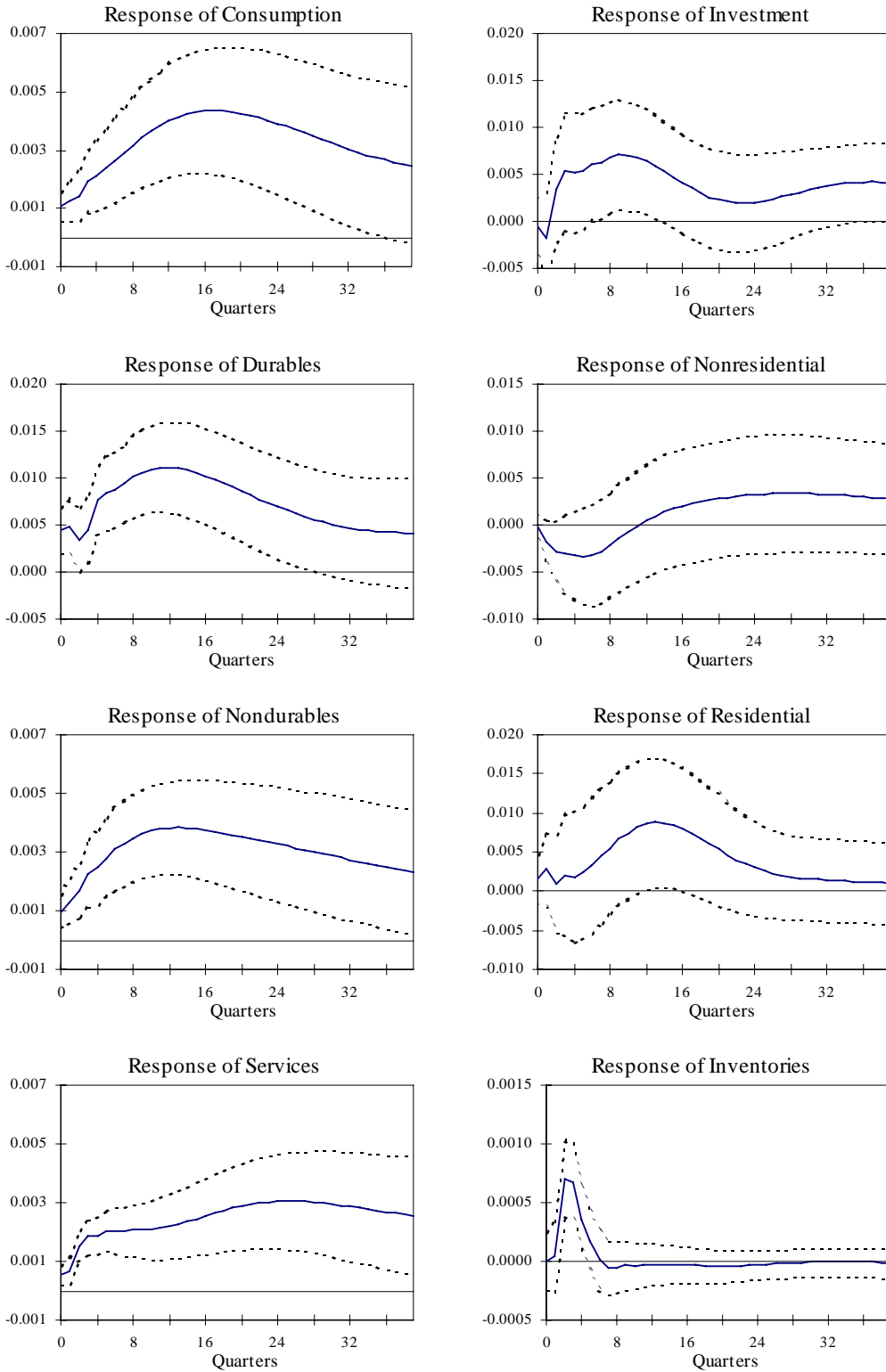


Figure 2: Responses of Consumption and Investment Components to an Increase in Government Spending

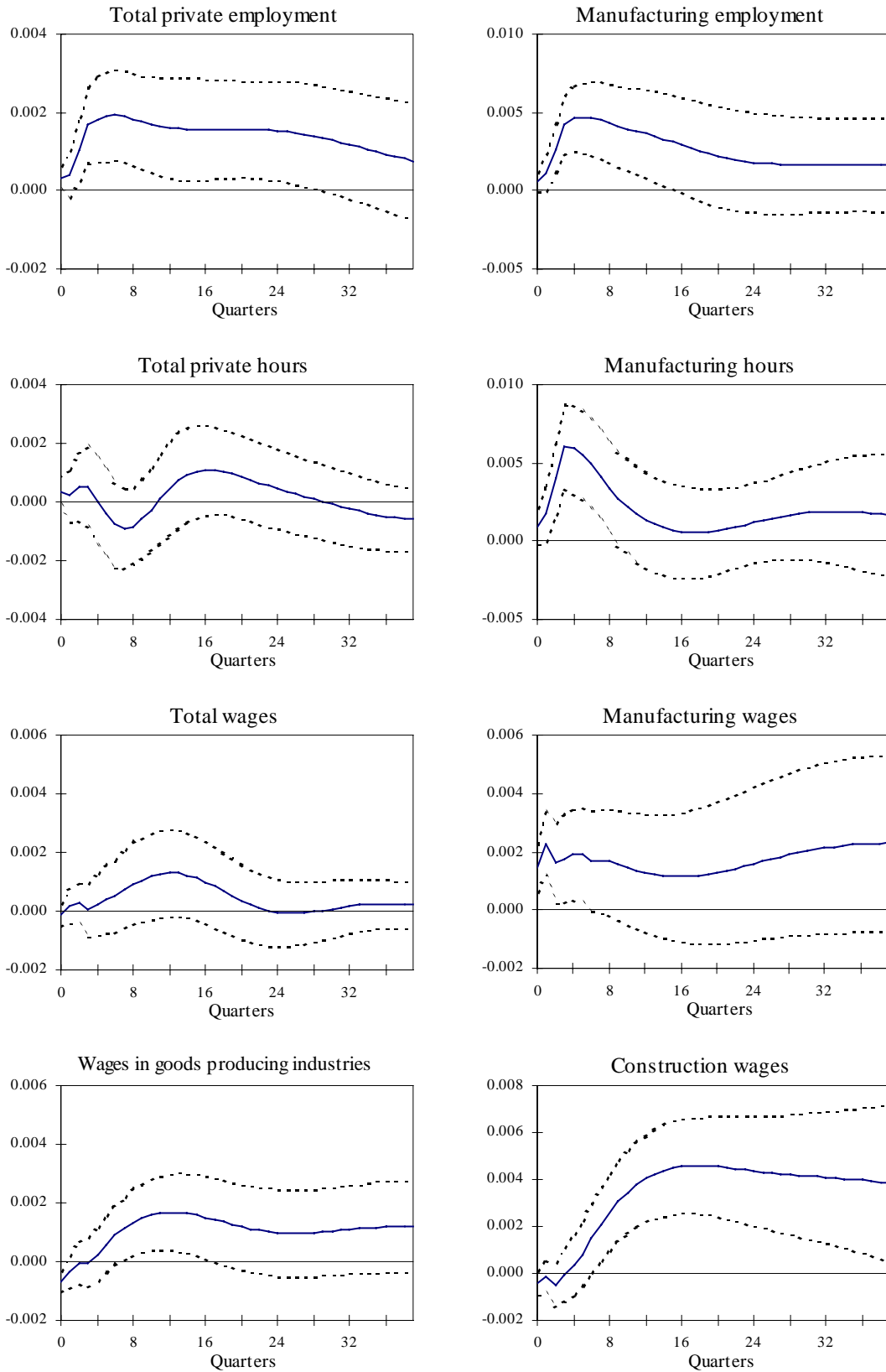


Figure 3: Responses of Wages, Hours, and Employment to an Increase in Government Spending

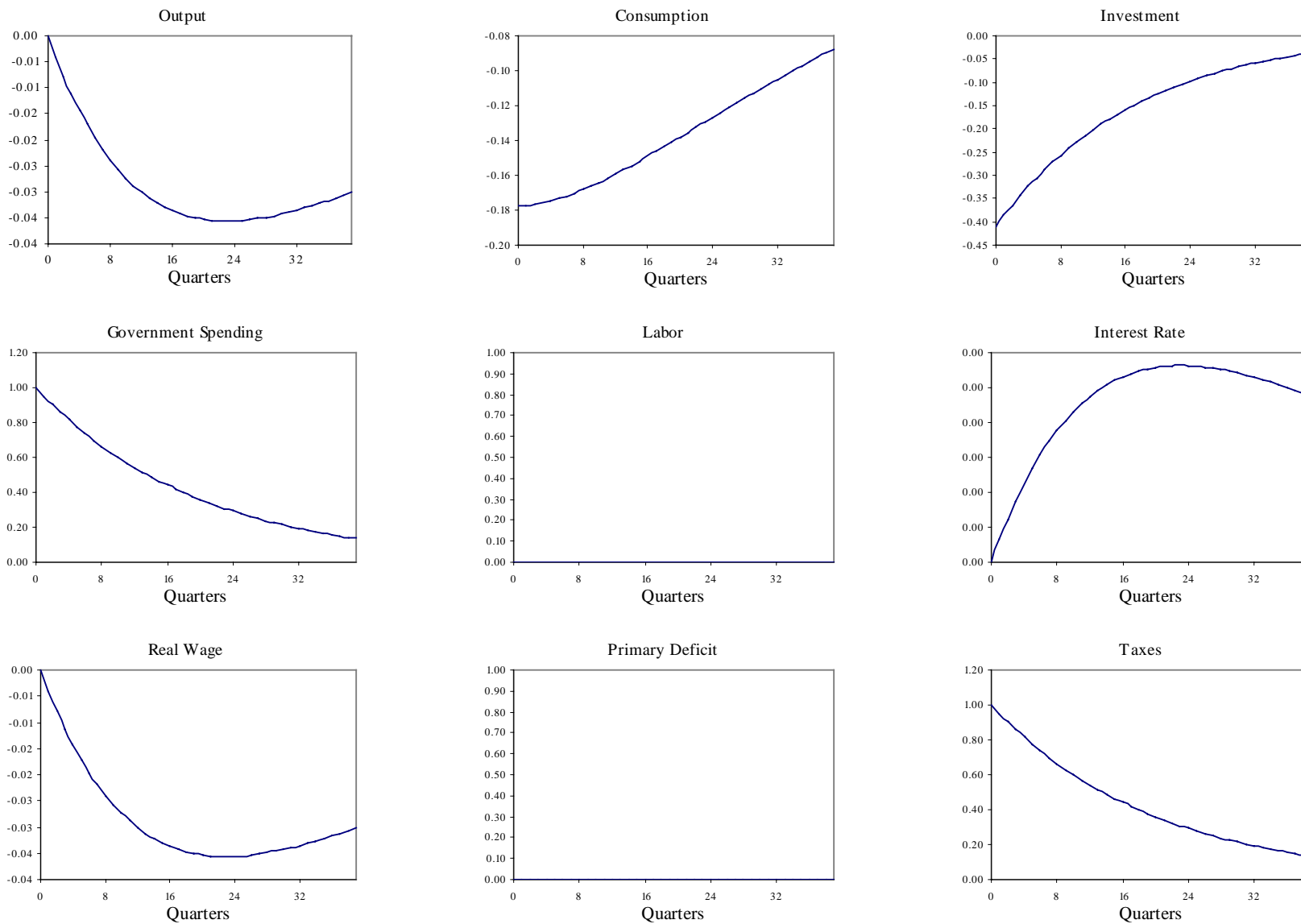


Figure 4a: Responses to an increase in G financed with lump sum taxes ($\sigma_n = 0$)

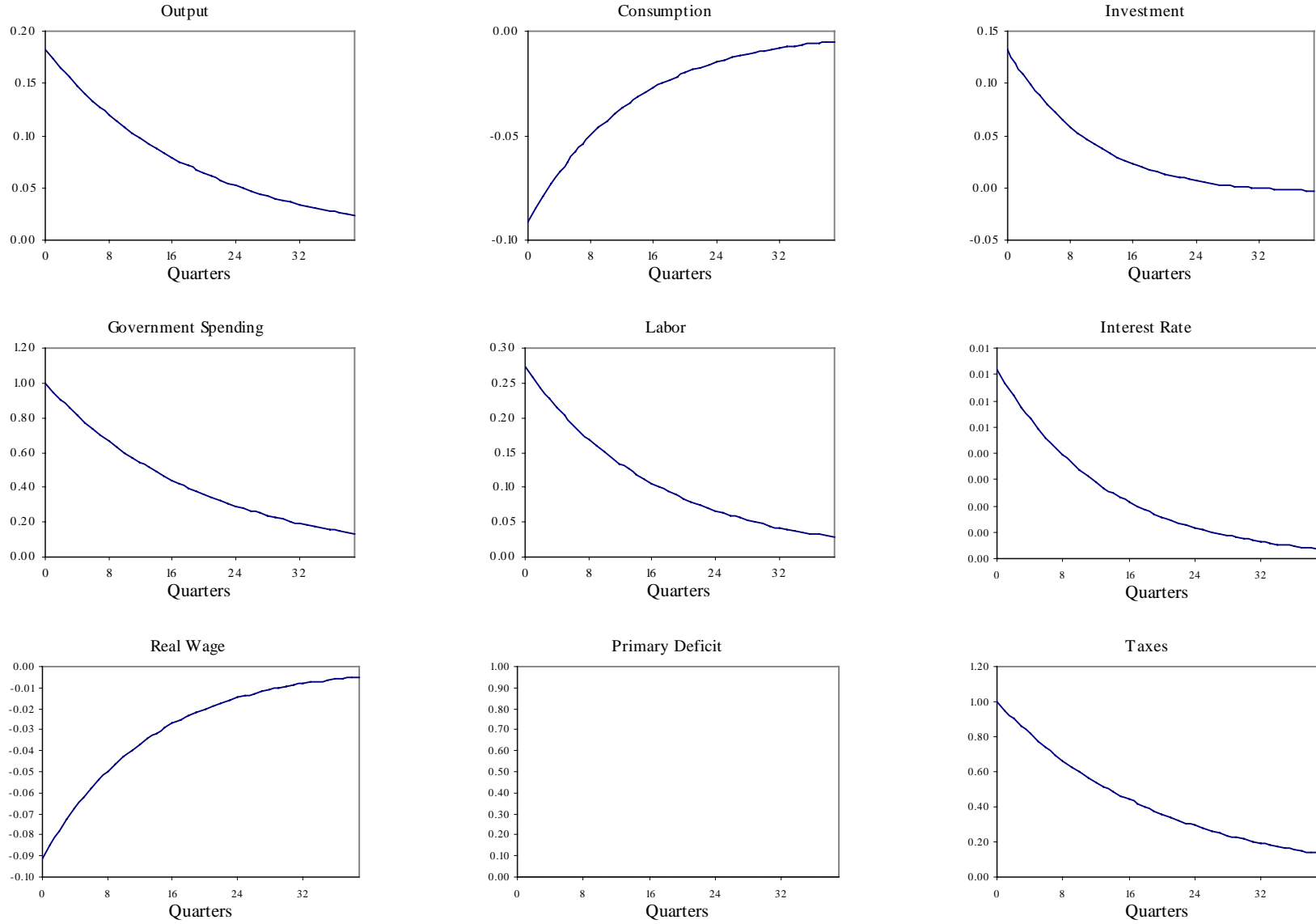


Figure 4b: Responses to an increase in G financed with lump sum taxes ($\sigma_n = \infty$)

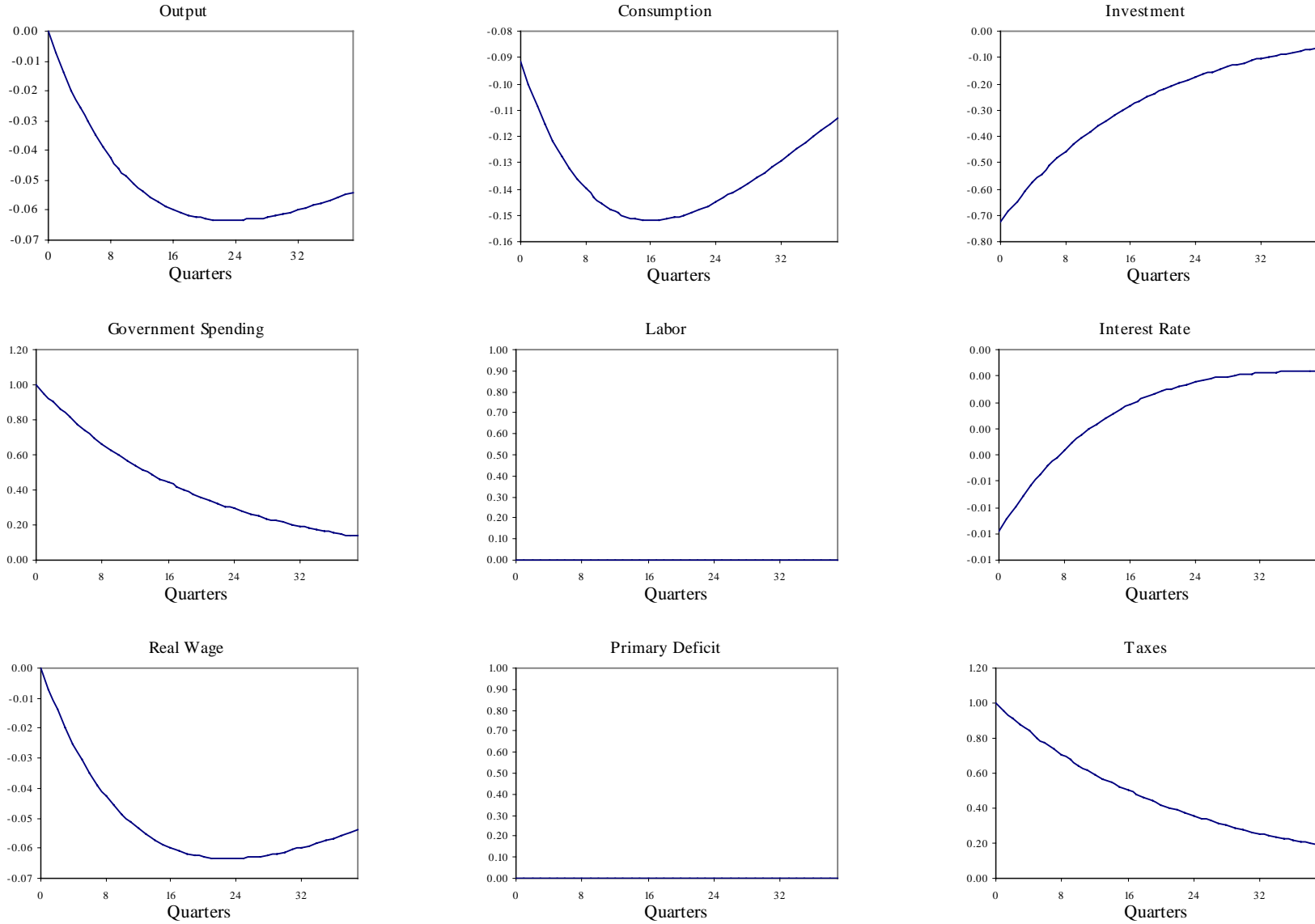


Figure 5a: Responses to an increase in G financed with distortionary taxes ($\sigma_n = 0$)

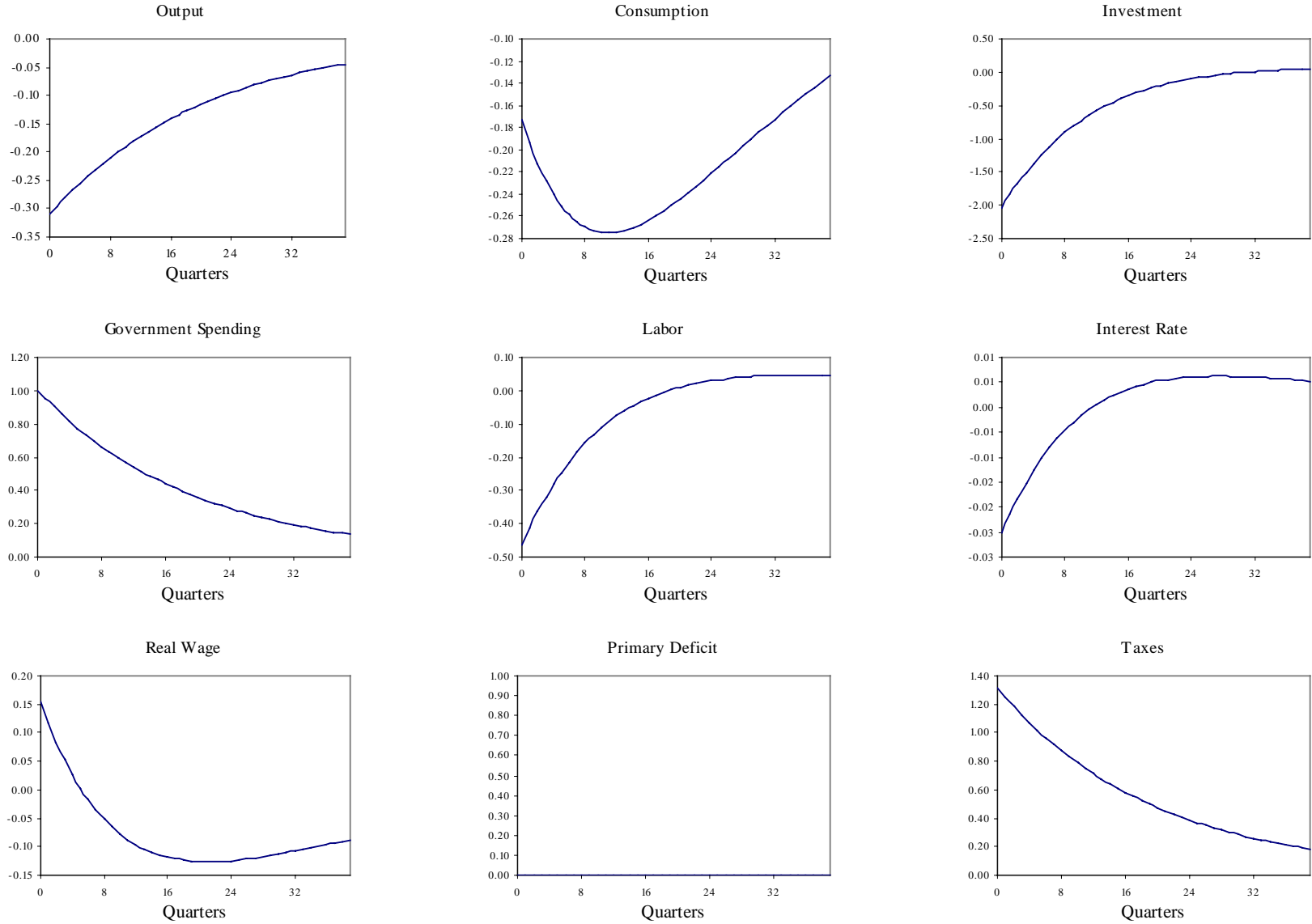


Figure 5b: Responses to an increase in G financed with distortionary taxes ($\sigma_n = \infty$)

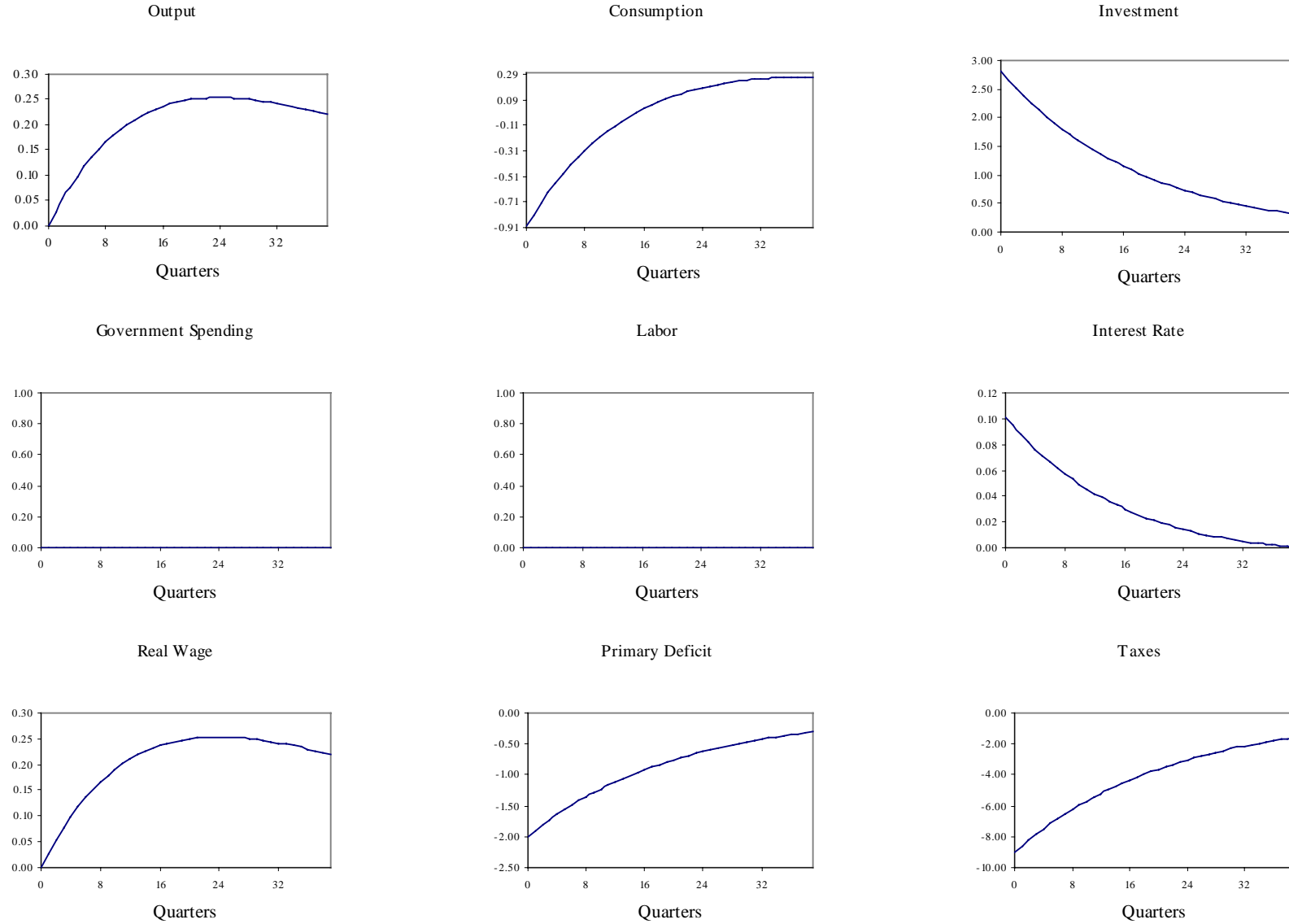


Figure 6a: Responses to a deficit-financed tax cut ($\sigma_n = 0$)

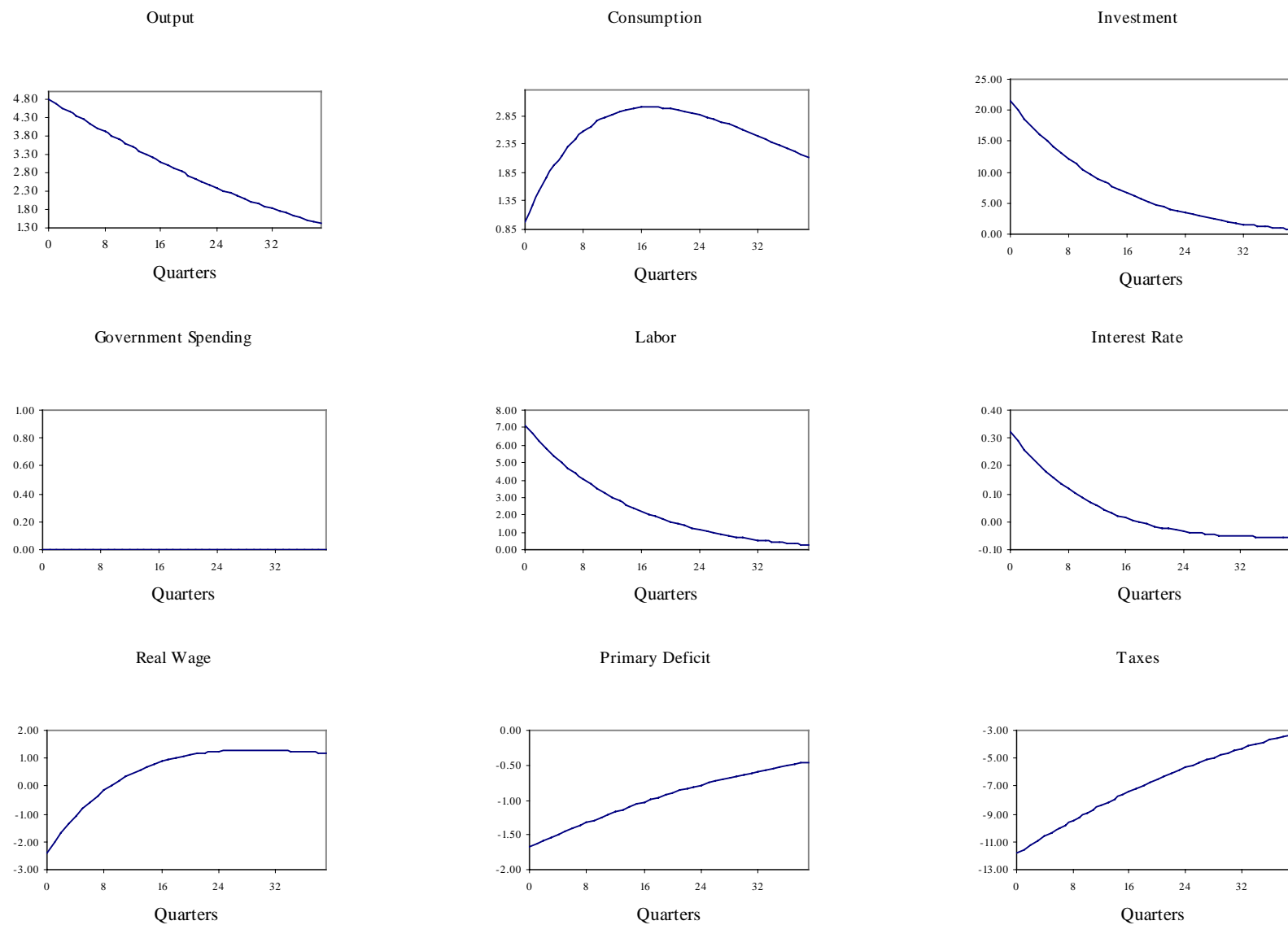


Figure 6b: Responses to a deficit-financed tax cut ($\sigma_n = \infty$)

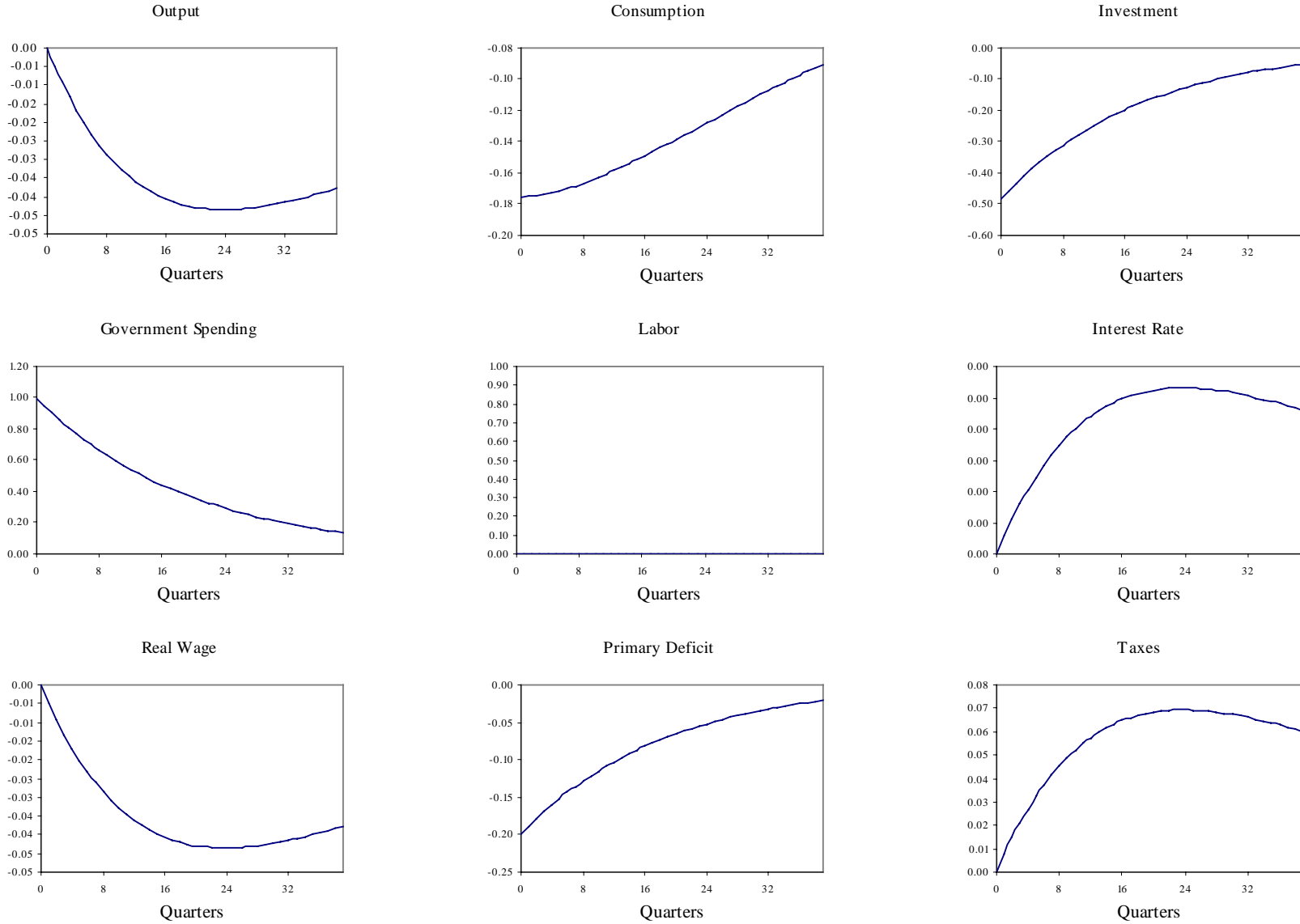


Figure 7a: Responses to a deficit-financed spending increase ($\sigma_n = 0$)

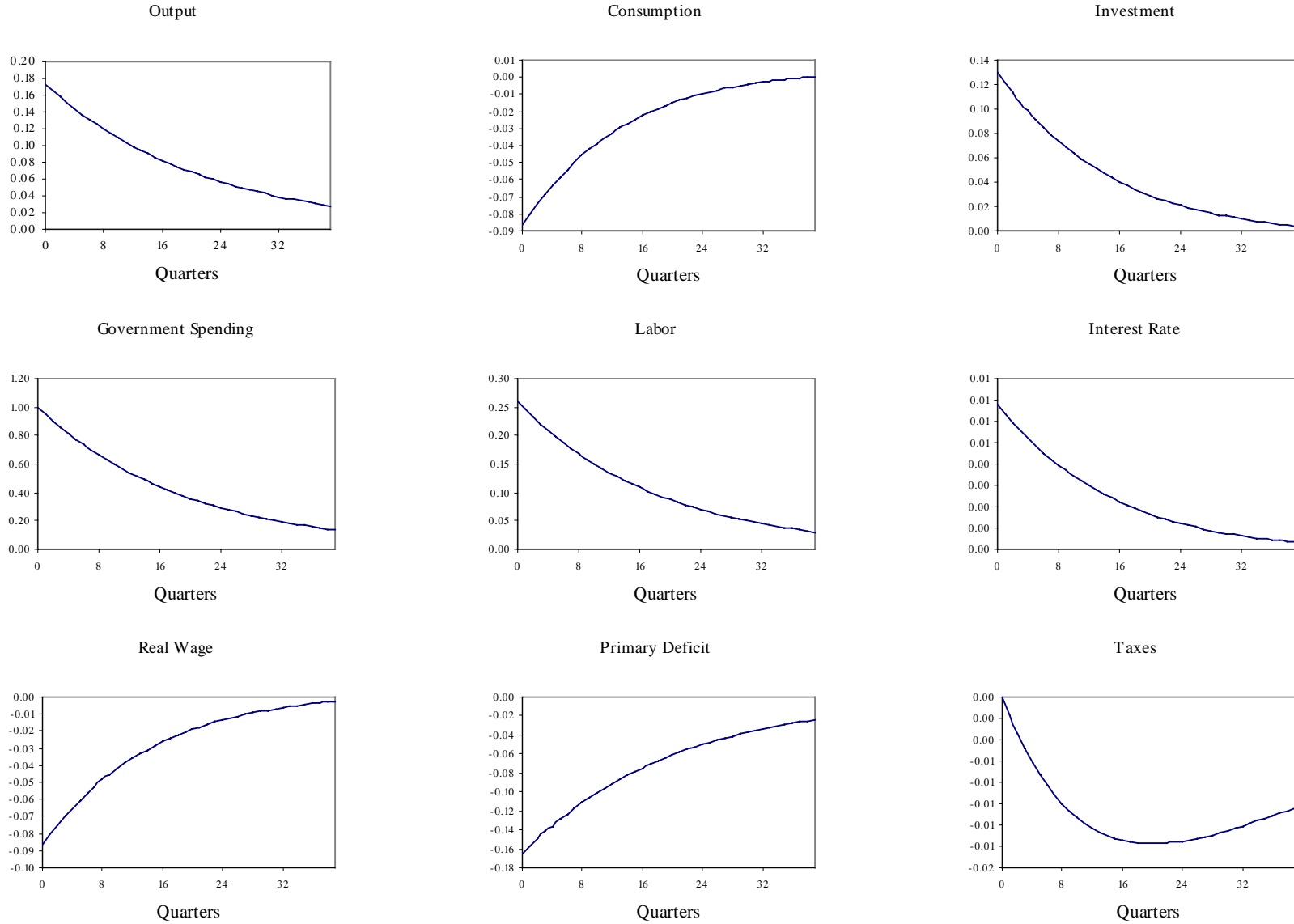


Figure 7b: Responses to a deficit-financed spending increase ($\sigma_n = \infty$)