FISCAL POLICY AND GROWTH

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Abstract

In the literature neither taxes, government spending nor deficits are robustly correlated with economic growth when evaluated individually. The lack of correlation may arise from the inability of any single budgetary component to fully capture the stance of fiscal policy. We use pair-wise combinations of fiscal indicators to assess the relationship between fiscal policy and U.S. growth.

We develop a VAR methodology for evaluating simultaneous shocks to more than one variable and use it to examine the impulse responses for simultaneous, unexpected and equivalent structural shocks to pair-wise combinations of fiscal indicators. We also exploit the identity relationship between taxes, spending and deficits and follow Sims and Zha (1998) to evaluate an unexpected structural shock to one included fiscal indicator, holding constant the other included indicator. We find that an increase in the size of federal government leads to slower economic growth, that the deficit is an unreliable indicator of the stance of fiscal policy, and that tax revenues are the most consistent indicator of fiscal policy.

The macroeconomic relationship between fiscal policy and economic growth has long fascinated economists. Unfortunately, analyses of that relationship have frustrated empiricists for almost as long. One root of that frustration is the array of possible policy indicators. As Tanzi and Zee (1997) discuss, there are three candidate indicators of fiscal policy—government expenditures, taxes and deficits. The literature does not systematically favor one indicator of fiscal policy over the others.[1] Furthermore, Levine and Renelt (1992) find that none of these fiscal indicators is robustly correlated with economic growth when evaluated individually.

The fragility of fiscal indicators found in Levine and Renelt (and the contradictory findings of the growth literature in general) probably arises from the inability of any single budgetary component to fully capture the stance of fiscal policy. For example, an increase in government expenditures could be considered expansionary if it were financed by deficit spending. However, it could also be considered contractionary if it were financed by an increase in taxes because such a policy would imply an increase in the size of the public sector. Interestingly, Martin and Fardmanesh (1990) find evidence supporting both conclusions when they simultaneously evaluate the growth effects of expenditures, taxes and deficits. Kocherlakota and Yi (1997) find that taxes effect growth only when public capital is held constant.

While no single indicator can capture the stance of fiscal policy, pair-wise combinations of the fiscal indicators describe a range of important fiscal policy actions. We consider three—a cut in taxes financed by a corresponding increase in the deficit, an increase in government

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[1] Many authors have used government expenditures to measure the stance of fiscal policy e.g. Ram 1986, Aschauer 1989, Barro 1977, 1978, 1990, Easterly and Rebelo 1993, Barro and Sala-I-Martin 1995, Ambler and Paquet 1996). Other authors have used tax rates (e.g. Engen and Skinner 1996, Rebelo 1991, Xu 1994, Lucas 1990, Stokely and Rebelo, 1995) or deficit measures (e.g. Easterly and Rebelo 1993, Martin and Fardmanesh 1990).

expenditures financed by a corresponding tax increase, and an increase in government expenditures financed by a corresponding increase in the deficit—and examine each policy action using two complementary vector autoregressive (VAR) techniques. We find that pair-wise analysis of fiscal policy yields generally stable and easily interpretable results across the various specifications. Our analysis of the 1983-2002 period suggests that tax cuts are consistently expansionary, spending increases are consistently contractionary, and deficit increases can be either expansionary or contractionary, depending on their impact on government size.

Analytical Framework

Because the time path of policy is generally uncertain, we use two strategies to assess the relationship between fiscal policy and growth. We believe these two strategies capture plausible extremes for the time path of policy responses.

In our first strategy we develop a VAR methodology for evaluating simultaneous shocks to more than one variable and use it to examine the impulse responses for simultaneous, unexpected and equivalent structural shocks to pair-wise combinations of fiscal indicators (see Appendix). This approach guarantees that the initial shocks are of the same magnitude and lets the system play itself out. Fiscal responses in later periods are not subject to any specific restriction.

In the second, we exploit the identity relationship between taxes, spending and deficits. We follow Sims and Zha (1998) to evaluate an unexpected structural shock to one included fiscal indicator, holding constant the other included indicator. By suppressing any response in the second, included fiscal indicator, this strategy guarantees that the omitted fiscal indicator must completely accommodate any change in the shocked indicator in every period.

For example, consider an increase in government spending financed by an increase in taxes. We model this case first as a simultaneous increase in government spending and taxes; and second as an increase in government spending or taxes holding the deficit constant.

We examine the relationship between policy and growth using a five-variable VAR system. In addition to the indicators for growth (US_t) and fiscal policy $(F1_t, F2_t$ – pair-wise combinations of government spending, taxes and the deficit), we include the federal funds rate (M_t) and the GDP deflator (P_t). Including indicators for monetary policy allows us to examine the full range of national policies. We use the nominal federal funds rate as our monetary policy variable because "with the exception of the 1979-82 period, the Federal Reserve has implemented monetary policy by targeting the federal funds rate over short periods of time" (Balke and Emery 1994).[2] We include the deflator to capture the dynamics of the ex-post real interest relationship. Block exogeneity tests demonstrate that both monetary and fiscal policy variables belong in the model.

The Data

Data for this analysis come from a variety of sources and were seasonally adjusted where statistically appropriate. Because evidence suggests that the period prior to 1983 represents a different monetary policy regime, we restrict our attention to the period from January 1983 to

[2] Furthermore, a substantial literature suggests that the federal funds rate is a good proxy for the stance of monetary policy. For example, see Bernanke and Blinder (1992), Sims (1992), Christiano, Eichenbaum and Evans (1996), Bernanke and Mihov (1998), and Clarida, Gali and Gertler, (1999).

June 2002.[3] Augmented Dickey-Fuller tests indicated the series were stationary over that period.[4]

We consider monthly growth in nonfarm employment as our primary measure of economic growth, although analyses of quarterly growth in real GDP yield qualitatively similar results.[5] The quarterly GDP deflator is transformed via a Chow-Lin interpolation procedure into a monthly series using data on the producer price indices for finished goods, capital equipment, intermediate material and crude materials[6].

Our fiscal policy data come from the Department of the Treasury's *Monthly Treasury Statement*. We use unified-budget federal expenditures to measure government spending (GOVSPEND) and unified-budget federal receipts to measure taxes (TAXES). To preserve the linear relationship in the unadjusted data, we use the difference between these two series after seasonal adjustment to measure the unified budget deficit (DEFICIT). Following the literature, all of the fiscal variables are expressed as shares of GDP.[7]

The appropriate specification of a VAR system depends critically on the number of lags.

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3 For example, see Balke and Emery (1994).

4 The federal funds rate was not stationary during the period in question. However, it is stationary over longer periods and considered stationary in the literature.

5 The impulse responses for GDP and employment were qualitatively similar across the various models, but the confidence bands on the GDP joint impulse responses were quite large. Therefore, we only report results for the employment growth models

6 Chow and Lin (1971) has detailed explanation of this method.

7 We use a Chow-Lin interpolation procedure and seasonally adjusted data on total nonfarm employment to transform nominal GDP into a monthly series, and then divide seasonally-adjusted fiscal variables by the corresponding monthly GDP.

We use the Akaike information criterion (AIC) to suggest the appropriate lag length.[8] The AIC indicates that the appropriate specification would include 5 lags of each variable for the employment-growth VAR model.

Results

The first policy experiment we consider is an increase in government spending that is financed by an increase in taxes. Such a policy can be modeled as a simultaneous increase in government spending and taxes; as an increase in government spending holding the deficit constant; or as an increase in taxes holding the deficit constant.

The first column of Chart 1a presents impulse responses to a simultaneous, unexpected and equivalent shock to government spending and taxes. The upper figure in the column presents the impulse response for employment growth while the lower presents the cumulative impact of those responses on the employment growth rate. As the upper figure shows, an increase in spending and taxes leads to a decrease in employment growth that is significant for two years. As the lower figure shows, this increase in the size of the public sector leads to a persistently slower rate of job growth.

The second column of Chart 1a presents the Sims-Zha experiment of increasing government spending holding the deficit constant, while the third column presents the Sims-Zha experiment of increasing taxes holding the deficit constant. Again, the upper figures present impulse responses and the lower figures present the cumulative impact on the growth rate. As the chart illustrates, both Sims-Zha experiments confirm the joint-shock analysis. An increase in government spending and taxes persistently reduces the rate of job growth.

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[8] For a further discussion of model selection criteria, see Mills (1990) or Kennedy (1992).

Chart 1b describes our second policy action—a tax cut financed by an increase in the deficit. The first column presents the response of employment growth to a decrease in taxes and a simultaneous, equivalent increase in the deficit. As the two figures show, a tax cut financed by an increase in the deficit leads to a persistent increase in the rate of employment growth. The joint shock confidence bands suggest that the impulse is significant for nearly two years, and that the cumulative effect persists for at least five years. The equivalent Sims-Zha experiments—an increase in the deficit holding government spending constant and a decrease in taxes holding government spending constant—support similar conclusions (see columns 2 and 3).

Chart 1c illustrates an increase in the deficit that finances a spending increase rather than a tax cut. In sharp contrast to the previous case, this policy action leads to a decline in employment growth. As the first column shows, the impulse is significant for 20 months while the rate of employment growth is significantly lower for almost four years.

As in the previous two cases, the Sims-Zha analysis produces qualitatively similar yet quantitatively dampened results. Given that the Sims-Zha technique limits the channels through which policy is transmitted, such a dampening is not unexpected.

Taken as a whole, the three policy cases support two broad conclusions. First, growth in government stunts general economic growth. Regardless of how it is financed, an increase in government spending leads to slower economic growth.[9] Second, the deficit is an unreliable indicator of the stance of fiscal policy. Depending on the budgetary action being financed—a tax cut or spending increase—an increase in the deficit can be either expansionary or contractionary.

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[9] While this conclusion runs contrary to the traditional "Keynesian" effects of fiscal policy, it is consistent with recent work by Engen and Skinner (1992) and Alesina et al. (1999).

Tax increases that reduce the deficit are contractionary where spending cuts that accomplish the same goal are expansionary.

Sensitivity Analysis

While our pair-wise analysis of fiscal variables yields generally stable and easily interpretable results, analyzing a fiscal variable in isolation can be misleading. To illustrate the need for a pair-wise approach, we calculated impulse responses to single shocks with a four-variable model which includes only one fiscal variable. In the four- variable model, increases in the deficit are expansionary and significant from the fourteenth month for a year and a half. Increases in government spending are also expansionary but insignificant (Chart 2). In the model with taxes as the fiscal variable, an unanticipated increase in taxes leads to a decline in employment growth which is significant for roughly a year and a half. While such patterns may be consistent with conventional wisdom, the patterns for the deficit and government spending are inconsistent with the findings of the joint shock analysis.

To see whether a single shock would give more consistent results with a better specified model which included pair-wise combinations of fiscal policy, we also use our five-variable model to obtain impulse responses for employment growth from a shock to the deficit, tax revenues and government expenditures (Chart 3). Consistent with the joint-shock analysis, an increase in taxes – whether to finance an increase in government spending or a cut in the deficit– generates declines in employment growth. However, the response of employment growth to a shock in government spending or the deficit are not consistent. Increases in government spending have no impact on employment growth in the model with taxes and lead to declines in employment growth in the model with the deficit. The impulse responses to a singleton shock to the deficit are expansionary and significant regardless of whether the model pairs the deficit with taxes or government spending. In contrast, the joint-shock analysis indicates that increases in the deficit are contractionary when used to finance increases in government spending. Scholars relying on impulse responses to such single shocks could reach the mistaken conclusion that deficit spending is reliably expansionary.

Conclusions

While no single indicator can capture the stance of fiscal policy, pair-wise combinations of government expenditures, deficits and taxes can describe a range of important fiscal policy actions. To examine the relationship between fiscal policy and growth we develop a vector-autoregressive methodology for evaluating pair-wise combinations of government expenditures, deficits and taxes.

Our analysis of the 1983-2002 period supports three broad conclusions about the U.S. economy. First, growth in government stunts general economic growth. Increases in government spending or taxes lead to persistent decreases in the rate of job growth. Second, the deficit is an unreliable indicator of the stance of fiscal policy. Depending on the budgetary action being financed (a tax cut or spending increase), an increase in the deficit can be either expansionary or contractionary. Tax increases that reduce the deficit are contractionary whereas spending cuts that accomplish the same goal are expansionary. Strikingly, this conclusion is only evident from the joint-shock analysis; analyses of singleton shocks (whether in a model with a single fiscal indicator or a more appropriately specified model with two fiscal indicators) imply that increasing the deficit is always expansionary. Finally, we find that tax revenues are the most consistent indicator of fiscal policy. Models that include taxes as one of the indicators of fiscal policy are remarkably robust, although taxes can only describe the full range of policy options when combined with another policy indicator.

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Appendix:

The VAR model can be expressed in its moving-average representation showing the cumulative effect on the current level of the variables of current and past structural shocks:

$$Y_t = A(L)\nu_t \qquad [1]$$

where $Y_t = (M_t \quad P_t \quad F1_t \quad F2_t \quad US_t)^T$ and $\nu_t = (\nu_{mt} \quad \nu_{pt} \quad \nu_{f1t} \quad \nu_{f2t} \quad \nu_{ust})^T$ and where the matrix lag polynomial A(L) contains all the parameters that measure the response over time of the variables of the system to previous economic disturbances. To identify the set of structural parameters contained in A_0, the VAR model is first estimated in its reduced VAR form:

$$Y_t = B_1 Y_{t-1} + B_2 Y_{t-2} + \ldots + B_k Y_{t-k} + \mu_t \qquad [2]$$

where k is the number of lags included in the estimated VAR and $E(\mu_t \mu_t^T) = \Sigma$, the variance-covariance matrix of reduced-form residuals. This reduced form's moving-average representation links the current values of the variables to contemporaneous and past reduced-form residuals:

$$Y_t = C(L)\mu_t \qquad [3]$$

Comparing equations [1] and [3], the reduced-form residuals, which have no economic meaning *per se*, can be expressed as a linear combination of the economic disturbances according to:

$$\mu_t = A_0 \nu_t \qquad [4]$$

Hence, the variance-covariance matrix of the reduced-form shocks can be related to that of the structural shocks as follows:

$$E(\mu_t \mu_t^T) = A_0 \Omega A_0^T = \Sigma \qquad [5]$$

where $\Omega = E(\nu_t \nu_t^T)$ is the variance-covariance matrix of the structural disturbances.

We use Choleski decomposition to identify the structural shocks using the error structure:

$$
\begin{aligned}
\mu_m &= \nu_m \\
\mu_p &= c_{21}\mu_m + \nu_p \\
\mu_{f1} &= c_{31}\mu_m + c_{32}\mu_p + \nu_{f1} \\
\mu_{f2} &= c_{41}\mu_m + c_{42}\mu_p + c_{43}\mu_{f1} + \nu_{f2} \\
\mu_{US} &= c_{51}\mu_m + c_{52}\mu_p + c_{53}\mu_{f1} + c_{54}\mu_{f2} + \nu_{US}
\end{aligned}
$$

where μ_m, μ_p, μ_{f1}, μ_{f2} and μ_{US} represent the residuals from the five equations, and ν_m, ν_p, ν_{f1}, ν_{f2} and ν_{us} the structural disturbances in the VAR system.

We choose to normalize the shocks to one standard deviation of the structural form disturbance ν_t. In the joint-shock strategy, the first period structural shock ν_t is translated to first period reduced form innovation μ_t according to [4]. $\Omega^{1/2}$ is the diagonal matrix with the standard deviation of ν_t, σ_{ii} (i=1..5), on the diagonal. Assume e^i is the unit column vector with one at ith row and zero elsewhere. For a single structural shock on the ith variable, $\Omega^{1/2}e^i$ is the first period shock vector, and the corresponding reduced form innovation is calculated by:

$$\mu_t = A_0\Omega^{1/2}e^{i}$$

Similarly, for multiple simultaneous structural shocks to the ith and jth variable, the corresponding reduced form innovation is calculated by:

$$\mu_t = A_0\Omega^{1/2}(e^{i} + e^{j})$$

In order to analyze the case of simultaneous structural shocks to the ith and jth variable of equal magnitude, we take one standard deviation of ν_{it} as the base. The first period shock vector is:

$$\mu_t = A_0\Omega^{1/2} * (e^{i} + x^{j})$$

where x^j is a column vector with the jth element equal to σ_{ii}/σ_{jj} and elsewhere zero.

In the second strategy, we let only one included fiscal indicator respond to the initial shock. Following Sims and Zha's approach of "shutting down" the policy response that would otherwise be implied by the VAR estimates, we set the first fiscal indicator to its lagged value initialized at the beginning of the forecast period. We simulate the system using this "shut down" equation and all the other structural equations implied by the identification scheme discussed above. The initial shock is still set to be one standard deviation of the structural form disturbance ν_t.

Confidence bands

To facilitate statistical inference, we construct confidence bands of the impulse response functions. In practice, two general methods to construct confidence bands of impulse response functions have been used—the Bayesian method and the bootstrapping method. Sims and Zha (1999) argue that likelihood-characterizing bands such as the Bayesian posterior probability intervals are the best approach to providing error bands in time series models. Sims and Zha (1994) also conclude that Bayesian intervals have a firmer theoretical foundation in small samples, are easier to compute, and are about as good in small samples by classical criteria as are the best bootstrap intervals; while bootstrap intervals based directly on the simulated small-sample distribution of an estimator, without bias correction, perform very poorly.

In the joint-shock strategy, we calculate the Bayesian posterior probability confidence interval with one standard-deviation, using Monte-Carlo integration with 1000 replications. We follow Kloek and Van Dijk (1978) with the coefficient draws taken directly from the estimated posterior distribution of the coefficients of the VAR system. Our computational contribution is to expand similar existing procedures to cover the case with two simultaneous, equivalent structural shocks. These confidence bands can be used to distinguish where the impulse response functions differ significantly from zero. Whenever the lower bound on the impulse response function is positive, we consider the impulse to be significantly positive. Whenever the upper bound on the impulse response is negative, we consider the impulse to be significantly negative.

Unfortunately, the comparable posterior distribution is prohibitively difficult to specify under the Sims-Zha restrictions. Therefore, we explored using the bootstrapping method to generate confidence bands for the Sims-Zha impulse responses.[10] Unfortunately, as is often the case, the resulting simulated impulse response functions are explosive. Hence, we do not report confidence bands for the Sims-Zha strategy.

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[10] Runkel (1987) has detailed explanation of this method.

Chart 1a: An Increase in Government Spending Financed by Taxes

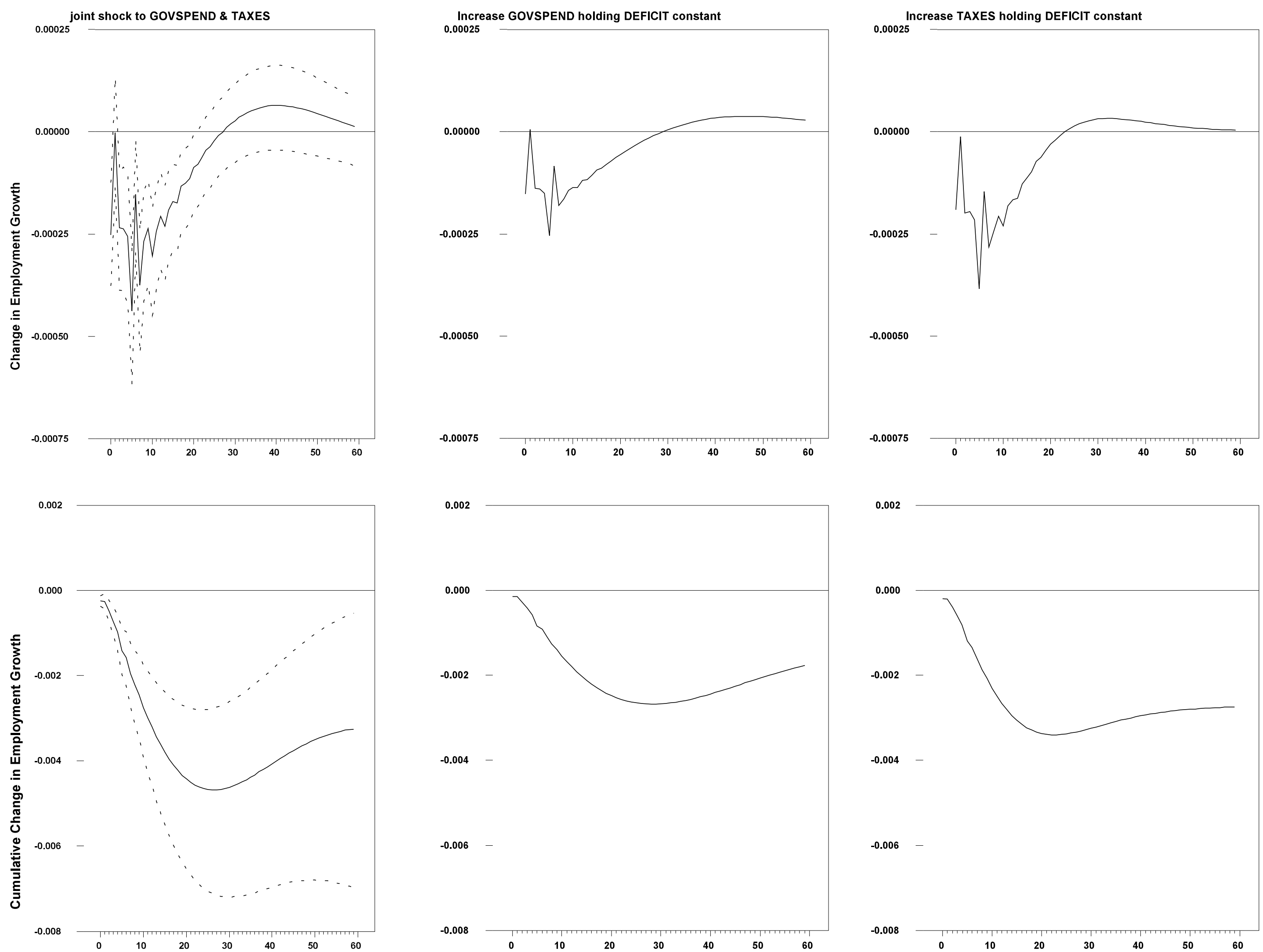

Chart 1b: A Tax Cut Financed by Deficit Spending

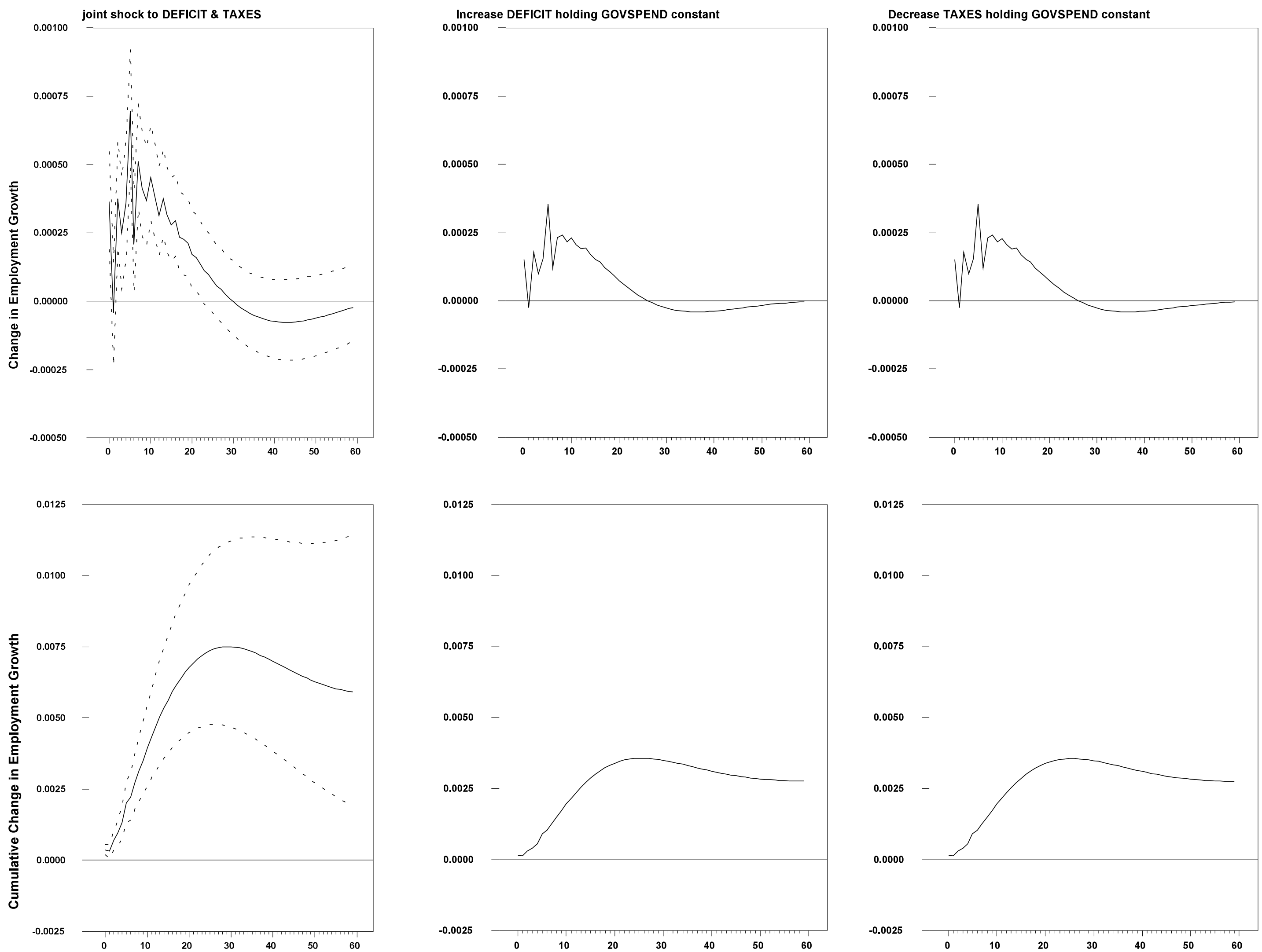

Chart 1c: An Increase in Government Spending Financed by Deficit

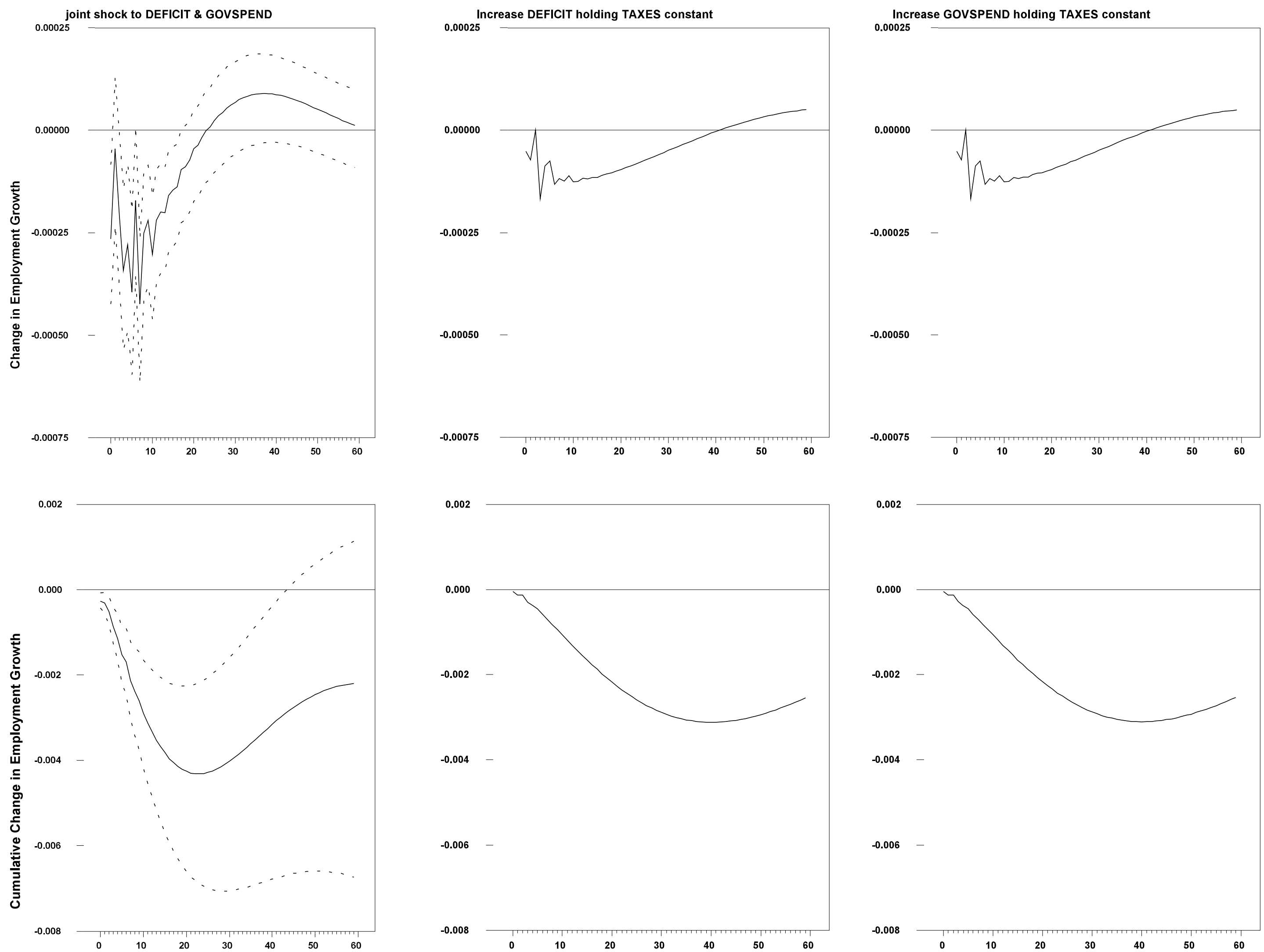

Chart 2: Impulse Responses in 4-Variable Models

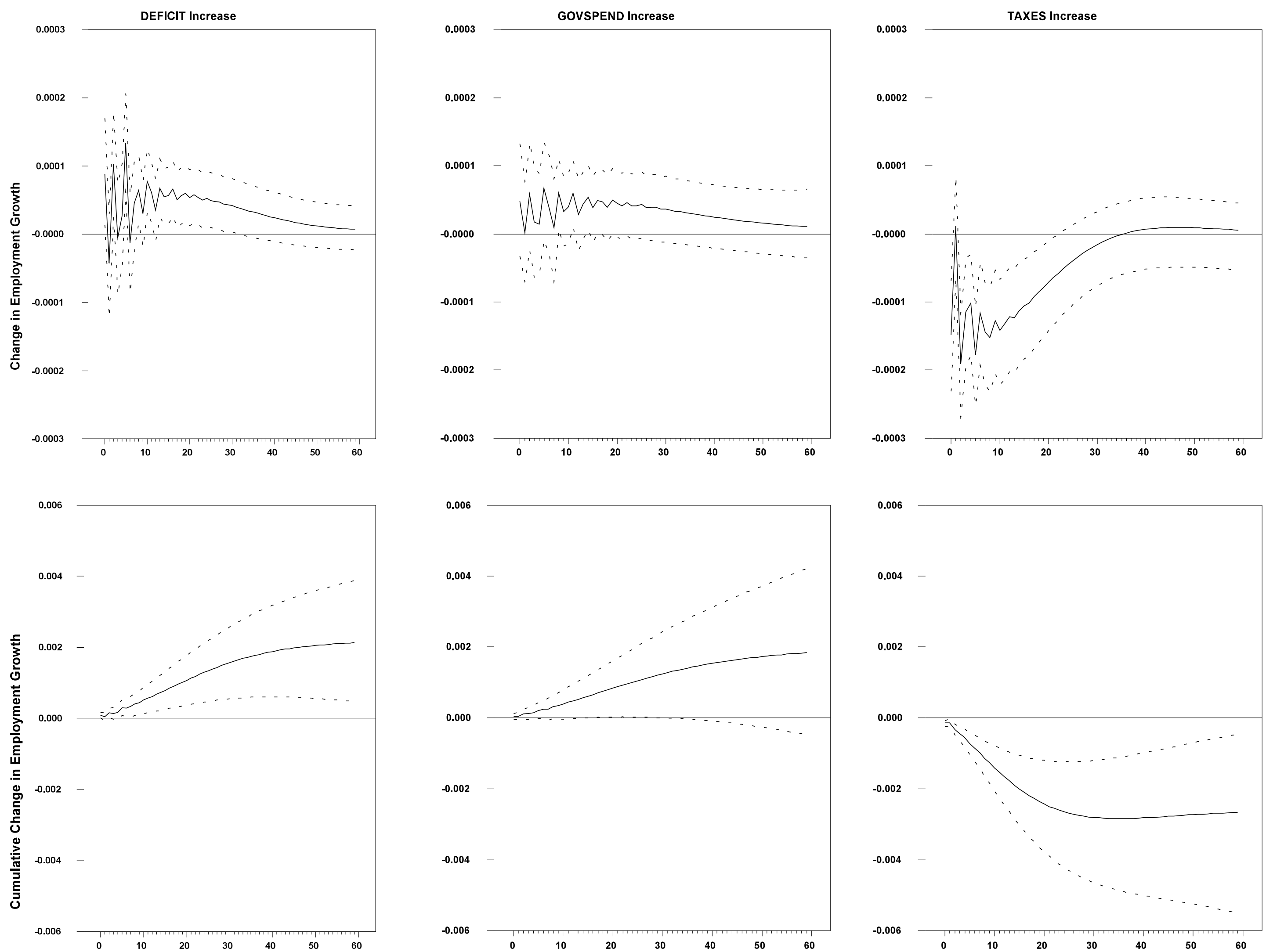

Chart 3: Cumulative Changes in Employment Growth
(Single Shocks in 5-Variable Models)