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Fiscal Shocks, the Trade Balance, and the Exchange Rate

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Abstract

This paper investigates empirically, using a VAR model, the response of the exchange rate and the trade balance to fiscal policy shocks for the U.S. economy during the period 1981:3-2006:3. The results indicate that positive shocks to real government purchases generate a persistent increase in the budget deficit, a transitory expansionary effect on output, and a long-lived positive effect on the price level, but reduce the real interest rate. Simultaneously, and consistent with interest parity, the real exchange rate depreciates, and the trade balance improves. Negative shocks to net taxes also generate a persistent increase in the budget deficit, and the effects on the model variables are generally in the same direction, but are almost never significant. Our results indicate it is inappropriate to attribute rising trade balance deficits to expansionary fiscal policy shocks, even though these shocks generate long-lived increases in the budget deficit.

JEL Classification: F42, E20

Key Words: Fiscal Policy, Trade balance, Exchange Rates, VAR Models

1. Introduction

The U.S. current account deficit was about six and one half percent of GDP in the third quarter of 2006, despite the depreciation of the U.S. dollar against major currencies during 2004-2006. The increasing U.S. fiscal deficits stemming from expansionary fiscal policy have been blamed for the rising current account deficits. The relationship between the current account and fiscal policy is of great theoretical and empirical interest in open economy macroeconomics, and it has also important policy implications for the role of fiscal policy in reducing the current account deficits.

Although discussions of the relation between budget deficits and current account deficits in the popular press often assign a causal role running from budget deficits to current account deficits, theoretical models don't provide a uniform view of the effect of fiscal policy actions on the real exchange rate and the current account.

Models in the Mundell-Fleming tradition (Mundell (1963), Fleming (1962), Dornbusch (1976), Marston (1985), and Flood and Marion (1982)) predict that, in a floating rate regime and assuming wage and/or price rigidities and that the Marshall-Lerner condition holds, expansionary fiscal policy actions raise the real interest rate, lead to an appreciation of the real exchange rate, and a deterioration in the current account.

Dynamic general equilibrium models, however, show that the effects of expansionary fiscal policy actions on the real exchange rate and the current account depend on whether the fiscal shock is permanent or temporary, whether international asset markets are complete or not, whether labor supply is fixed or variable, and how government expenditures are financed. For example, in Obstfeld (1981), under the assumption that government consumption does not enter into the household's utility

function, a tax-financed increase in government expenditure results in a current account surplus. In Baxter (1995), under the assumption that individuals can engage in consumption-smoothing, but not risk pooling (i.e., incomplete asset markets), and that prices are flexible, an unanticipated, permanent increase in government purchases financed by government borrowing in a small open economy with fixed labor input does not affect the current account. In a large economy with variable labor, however, there is a current account deficit. In Frenkel and Razin (1996) a temporary increase in government spending leads to a deterioration in the current account and an appreciation of the exchange rate.

Despite the popularity of the subject in policy analysis and the lack of consensus among different theoretical models, there is relatively little empirical evidence investigating the effects of fiscal policy on the exchange rate and current account. Vector Autoregressive (VAR) models, which have been used extensively to analyze the effects of monetary policy shocks, have recently been employed to analyze the effects of fiscal policy shocks on the economy[1], but there are only a few VAR studies that examine the effects of fiscal policy in open economy models. Rogers (1999) and Clarida and Prendergast (1999) investigate the effects of fiscal shocks on exchange rates, and Kearney and Monadjemi (1990) examine how budget deficits affect the current account. Only Kim and Roubini (2003) investigate how fiscal policy affects both the current account and the exchange rate.

The purpose of this paper is to investigate empirically how changes in fiscal policy affect the trade balance and the exchange rate. We focus on the trade balance rather than the current account since the trade balance is the driving force for changes in

the current account. Using data from 1980:1 to 2006:3 within a seven-variable VAR model of the U.S. economy, we investigate how shocks to real government purchases and real net taxes affect the real exchange rate and the trade balance, as well as output, the price level, and the real long-term interest rate. This paper is differentiated from previous work by employing a different set of macroeconomic variables that includes both output and the price level, as well as fiscal variables, the real interest rate, and the real exchange rate and the trade balance and by imposing somewhat different identifying restrictions for structural shocks to fiscal policy. The earlier studies of the effect of fiscal policy on the current account excluded the price level, which we believe, as explained below, is inappropriate when one wants to identify structural shocks to government purchases and net taxes. Further, unlike most previous studies whose sample spans periods of both fixed and flexible exchange rates, we focus on the period of flexible exchange rates, but, following Perrotti (2002) who showed that the effects of fiscal policy differed significantly in a sample that included only data from 1980-2000 from a sample that used data from the 1960s and 1970s, we begin our sample in 1980. Choosing this sample period also allows us to analyze the role of fiscal shocks on the trade balance during a period which was characterized by increasing current account deficits and no current account reversals.

The remainder of the paper is organized as follows. Section 2 describes the data and methodology used in the paper. The empirical results are presented and discussed in Section 3. Section 4 provides some extensions and checks for robustness. The results are summarized in the conclusion.

2. Data and Methodology

2.1. Data

The data used to estimate the model consist of quarterly observations for the U.S. for the period 1980:1-2006:3. After allowing for lags, the sample period for estimation of the model is 1981:3-2006:3. The data employed in this paper are obtained from Global Insight databases, from the Board of Governors of the Federal Reserve web site, and from the FRED data base of the Federal Reserve Bank of St. Louis. The sources for, and definitions of, the model variables are found in Table 1.

2.2. Methodology

To investigate the response of the exchange rate and the trade balance to fiscal policy innovations for the U.S. economy, a VAR model is employed. The model comprises the following seven variables: real GDP (*Y*), the price level (*P*, the GDP deflator), the interest rate (*r*, BAA rate), real government purchases (*G*), real net taxes (*T*), the real exchange rate (*RE*, the real trade-weighted exchange rate), and the trade balance (*TB*, ratio of real exports to imports). A long-term interest rate is used in light of arguments that investment expenditures are responsive to variations in these rates. Although the nominal interest rate is included, the effects of fiscal policy on the real ex post interest rate are generated endogenously as described below. Following most of the previous studies that examine the effects of fiscal shocks, the model is estimated in levels[2], and the natural logarithms of all variables except the interest rate are used. A lag of four quarters was used in the estimation, but the sensitivity of the results to alternative lag lengths and in other dimensions as well is investigated.

The VAR model is derived from the following structural model:

$$X_t = A_0 X_t + A_1 X_{t-1} + \cdots + A_q X_{t-q} + \varepsilon_t$$

where $X_t = \left[P_t, G_t, Y_t, r_t, T_t, RE_t, TB_t\right]'$ = vector of endogenous variables, A_0 = coefficient matrix specifying the contemporaneous relations among the variables in the model, A_i, $i = 1, \cdots, q$, are coefficient matrices on q lagged values of X, and ε_t = vector of structural shocks which are assumed to be uncorrelated. The VAR model is the reduced form of this structural model and can be written as:

$$X_t = B_1 X_{t-1} + \cdots + B_q X_{t-q} + U_t$$

where B_i, $i = 1, \cdots, q$, $= (I - A_0)^{-1} A_i$ and $U_t = (I - A_0)^{-1} \varepsilon_t$. U_t is the vector of reduced form residuals, and $U_t = \left[u_t^P, u_t^G, u_t^Y, u_t^r, u_t^T, u_t^{RE}, u_t^{TB}\right]'$. As can be seen from the definition of U_t, the elements of U_t will, in general, be correlated. Once the VAR model is estimated, the structural shocks can be recovered from the reduced form residuals by imposing restrictions on the contemporaneous relations among the model variables, i.e. by specifying the non-zero elements of A_0.

In this paper, the primary way structural shocks to fiscal policy are identified is from a Choleski decomposition of the variance-covariance matrix. The Choleski decomposition imposes a recursive contemporaneous causal structure on the model, i.e. A_0 is a lower-diagonal matrix with one's on the diagonal. The model variables are ordered in a particular sequence, and variables higher in the ordering are assumed to cause contemporaneous changes in variables lower in the ordering. Variables lower in the ordering are assumed to affect variables higher in the ordering only with a lag. To check

the sensitivity of the results to the recursive ordering chosen, we estimate a structural model that allows some contemporaneous feedback among model variables.

The ordering used is: *P, G, Y, r, T, RE, TB*. Because spending appropriation bills in the U.S. typically specify government purchases in current dollar terms, the price level is ordered before real government purchases. With spending levels specified in nominal terms, variations in the current price level affect the real value of government spending in the current period. As expected, the contemporaneous correlation between u_t^P and u_t^G is negative. Previous studies that ignore this contemporaneous relationship may well misestimate structural shocks to government purchases. With *G* ordered after *P*, structural shocks to *G* are assumed to affect *P* only with a lag. Given the common presumption of short-run rigidities in prices, this seems to be a reasonable assumption. *G* is, however, ordered before *Y* which allows changes in *G* to have contemporaneous effects on output, but allows only a lagged discretionary response of *G* to movements in *Y*. Allowing a contemporaneous effect of *G* on *Y* is appropriate since government purchases are a component of *Y* and can also affect inventories in the current period. Given the nature of decision and implementation lags in fiscal policymaking, specifying a discretionary response of government purchases only to lagged output is generally a good assumption.

With regard to net taxes (*T*), *P*, *G*, *Y*, and *r* are ordered before *T*. Automatic stabilizers imply a contemporaneous response of taxes and transfer payments to changes in macro variables like *P* and *Y*, so placing *T* after these variables allows for automatic stabilizing effects, but constrains changes in net taxes to affect the macroeconomy only with a lag. Since the U.S. tax code and transfer payments are not perfectly indexed to the

price level, variations in current prices can affect real net taxes, and previous studies that omit prices from the model thus ignore a source of feedback from the current state of the economy to net taxes and may consequently misestimate structural shocks to net taxes. Changes in r affect current interest payments on short-term debt that is rolled over, and since the measure of transfers used here includes interest payments on government debt, placing *T* after *r* allows changes in *r* to affect current net taxes. Changes in net taxes affect aggregate spending primarily by altering disposable income and hence consumption, and placing *T* after the macro variables implies a lag between a change in disposable income and the implementation of any resulting change in spending plans. Placing *G* before *T* implies that decisions about government purchases are made prior to decisions about taxes and that decisions about taxes and transfers affect government purchases only with a lag. This assumption is more controversial than ordering *T* after *P*, *Y*, and *r* since it is not uncommon for fiscal policymakers to simultaneously discuss plans for purchases and net taxes. The sensitivity of the results to this assumption is checked by estimating a structural VAR (discussed below) in which there is contemporaneous feedback between *G* and *T*.

The last two variables in the ordering are the real exchange rate and the trade balance. Since our focus is on the effects of fiscal shocks and since the real exchange rate and the trade balance are ordered after both fiscal variables, the effect of fiscal policy shocks on the real exchange rate and the trade balance will be exactly the same regardless of whether the real exchange rate is ordered before the trade balance or whether the trade balance is ordered before the real exchange rate. The ordering chosen allows contemporaneous effects of fiscal policy, prices, output, and the interest rate on the

exchange rate, and contemporaneous effects of these variables and the exchange rate on the trade balance.

The dynamic responses of output, the price level, the real interest rate, the real exchange rate, and the trade balance to shocks to government purchases and net taxes are analyzed by computing and plotting impulse response functions (IRFs) for a six year horizon. The IRF for the real interest rate is the difference between the IRF for the nominal interest rate and the annualized quarterly inflation rate implied by the IRF for the price level. Point estimates along with one standard deviation confidence intervals computed from Monte Carlo simulations employing antithetical acceleration and 10,000 draws are presented.

3. Empirical Results

Figure 1 presents the IRFs of the model variables to a positive innovation in real U.S. government purchases. The point estimates are the solid lines and the confidence intervals are represented by the dotted lines. We first note that the increase in government purchases is persistent. Government purchases remain above their initial level for approximately ten quarters after the shock. However, the effect on net taxes is not significant in virtually every period (as indicated by the fact that the confidence interval spans zero for all but a few horizons), which suggests that the shock to government purchases has a persistent effect on the government's budget deficit which dissipates only after approximately two and a half years. Output rises following the shock to purchases, and the effect is significantly different from zero for the first two quarters after the shock. However, output quickly returns to its initial level. The price level rises, and the effect becomes significant in the fourth quarter after the shock. The

price level remains significantly above its initial value for an extended period, but slowly begins to return to its initial value. The real interest rate *falls*, with a significant response after the first quarter, and the decline is very persistent. Although the real interest rate begins to rise back towards its initial value after a year, the real interest rate is significantly below its initial value for about three years, after which it returns to its initial value. The real exchange rate *depreciates* in response to a positive innovation in government purchases, and this response is significantly different from zero for an extended period of time. However, it eventually returns to its initial value. The response of the trade balance is positive in every period, and is significantly different from zero for an extended period, but returns to its initial value after about five years.

As expected, an increase in government purchases has a transitory positive effect on output and a long-lived effect on the price level. What seems surprising, however, is the way the real interest rate responds to the government purchases innovation. However, a decrease in the real interest rate following an expansionary shock to government purchases has been found before in the literature; Eichenbaum and Fisher (2005) find a very transitory negative effect on the real interest rate, but our results are similar to Kim and Roubini (2003) in that we find a very persistent negative effect on the real interest rate. Neither Mundell-Fleming-type models nor dynamic general equilibrium models predict a fall in the real interest rate in response to an increase in government purchases. The fall in the real interest rate, however, can be explained by the sticky-price intertemporal model of Obstfeld and Rogoff (1995), which is one of the building blocks of the New Open Economy Macroeconomics models. Obstfeld and Rogoff (1995) show that when current output increases relative to the long-run level of

output in response to a permanent increase in domestic government spending, individuals decrease their current consumption. This is related to consumption smoothing. Individuals want to increase their savings in the current period so that they can increase their consumption when their income is going to be relatively lower in the next period. Therefore, the real interest rate declines as saving increases. The increase in government purchases in our model isn't permanent, but it is long-lived, and, consequently, we would expect some consumption smoothing to occur.

Mankiw (1987) examines the dynamic impact of government purchases in a general equilibrium model, with both durable and nondurable consumer goods as well as productive capital, and shows that increases in government purchases may cause reductions in real interest rates. In Mankiw (1987), output produced may be consumed as a nondurable, added to the stock of the consumer durable good, added to the stock of productive capital, or purchased by the government. The consumer gets utility from durable and nondurable goods. A permanent increase in government purchases raises the marginal utility of consumption. This leads to conversion of some of the stock of consumer durables to productive capital. Therefore, the marginal product of capital and the real interest rate fall. The marginal utility of consumption rises less in response to a temporary change in government purchases. Therefore, a temporary change in government spending has a smaller impact on the real interest rate relative to a permanent change.

The finding that the real exchange rate depreciates in response to an increase in government purchases is also contrary to the predictions of Mundell-Fleming-type models and some dynamic general equilibrium models; however, it is consistent with the

fall in the real interest rate. The fall in the U.S. real interest rate and the depreciation of the real exchange rate are consistent with the interest rate parity relationship.

The improvement in the trade balance in response to a positive innovation to government purchases is counter to the belief that an increase in government purchases leads to twin deficits. A positive shock to government purchases leads to an increase in the government's budget deficit, but an improvement in the trade balance. However, the improvement in the trade balance in our model is consistent with the depreciation of the real exchange rate.

Figure 2 presents the IRFs of the model variables to a *negative* innovation in real net taxes. A shock to net taxes has a very persistent effect on itself, although net taxes return to their initial value after nine quarters. There are basically no significant effects on government purchases except for a small, transitory negative effect from quarters five through eleven, and in the brief period over which there is a transitory decline in government purchases, the magnitude of the decline in purchases is much smaller than the magnitude of the decline in net taxes. Consequently, a negative shock to net taxes increases the government's budget deficit in the short-run. The point estimate suggests little effect on output over the first eight quarters and thereafter output rises persistently, but the confidence interval rises above zero only for a brief period of time in quarters sixteen through twenty. There is a significant transitory effect on the price level; the increase in the price level is significant beginning in the third quarter after the shock and continuing through the sixteenth quarter, but is insignificant thereafter, although the point estimate is always positive. The effect on the real interest rate is somewhat erratic. The real interest rate initially rises slightly, but the increase is never significant. However,

thereafter, the real interest rate falls and is negative through quarter twelve, but the effect is significant only in the third quarter. Unlike the case of a positive shock to government purchases, there are essentially no significant effects of a negative shock to net taxes on the real interest rate even though, with the exception of the effect in the second quarter, the point estimate is negative through twelve quarters. The point estimate of the effect on the real exchange rate indicates initial depreciation of the real exchange rate, although the depreciation is not significant. The point estimate of the IRF for the trade balance indicates a deficit; however, the effect is essentially never significant (only in the eighth quarter does the confidence interval drop slightly below zero).

The IRFs of the model variables for a shock to net tax innovations are more difficult to interpret than are the IRFs for a shock to government purchases. This may reflect the hybrid nature of the net tax variable which subtracts transfer payments from total tax collections. However, even though the effects of a shock to the net tax variable are often in the same direction as the effects of a shock to government purchases, these effects are almost never significant. In particular, there are essentially no significant effects of a shock to net taxes on the real exchange rate, which is consistent with no significant effects on the real interest rate, and the lack of significance for the real exchange rate is consistent with no significant effect on the trade balance.

Our empirical results differ from the previous work in several ways, but since Clarida and Prendergast (1999), Rogers (1999), and Kearney and Manadjemi (1990) do not simultaneously estimate the effects of fiscal shocks on both the real exchange rate and the current account, it is most informative to compare our results to those of Kim and Roubini (2003) for the system in which they include both government purchases and net

taxes. Although there are similarities in the results, for example, a positive shock to government purchases lowers the real interest rate, leads to a depreciation in real exchange rate and moves the current account toward surplus, there are also differences. While we find that expansionary fiscal policy shocks, whether positive innovations to government purchases or negative innovations to net taxes, move output, the real interest rate, and the real exchange rate in the same direction, Kim and Roubini (2003) find that the responses of these variables to expansionary fiscal policy shocks to purchases and net taxes are asymmetric. The differences between our findings and the studies mentioned above may stem from the employment of different sample periods as well as from the use of different identification schemes.

4. Robustness of the Results

The robustness of the results reported in the previous section was checked in several ways, and graphs for the IRFs for the robustness checks are available on request. First, as noted earlier, the Choleski decomposition requires an assumption about whether government purchases decisions or net tax decisions are made first. In our ordering we assumed decisions about purchases were made before net tax decisions. We checked to see whether allowing decisions about purchases and net taxes to be made simultaneously had any effect on our results. In particular, we specified the contemporaneous relationships among the model variables (A_0) to be the following, assuming the same ordering of variables as before.

$$A_0 = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ \alpha_{21} & 1 & 0 & 0 & \alpha_{25} & 0 & 0 \\ \alpha_{31} & \alpha_{32} & 1 & 0 & 0 & 0 & 0 \\ \alpha_{41} & \alpha_{42} & \alpha_{43} & 1 & 0 & 0 & 0 \\ \alpha_{51} & \alpha_{52} & \alpha_{53} & \alpha_{54} & 1 & 0 & 0 \\ \alpha_{61} & \alpha_{62} & \alpha_{63} & \alpha_{64} & \alpha_{65} & 1 & 0 \\ \alpha_{71} & \alpha_{72} & \alpha_{73} & 0 & \alpha_{75} & \alpha_{76} & 1 \end{pmatrix}$$

We note that this specification allows a contemporaneous effect of *G* on *T* (α_{52} is allowed to be non-zero) and a contemporaneous effect of *T* on *G* (α_{25} is allowed to be non-zero). In order to achieve identification, one other specification change is made from the Choleski; the direct effect of the interest rate on the trade balance (α_{74}) is set to 0. This does not seem to be an unreasonable assumption. In the Choleski decomposition, this coefficient is not significantly different from 0. In the structural estimation, the coefficients α_{52} and α_{25} were both positive, but not significantly different from zero.[3] (In the Choleski decomposition, the contemporaneous effect of *G* on *T* is also positive, but not significant.) When the IRFs for shocks to the fiscal variables were computed using the structural decomposition, the point estimates for these IRFs lay entirely within the confidence intervals for the Choleski decomposition with the exception, not unexpectedly, of the contemporaneous effect of net taxes on government purchases. Thus the previous results are robust to allowing contemporaneous simultaneity between *G* and *T*.

A second structural model was estimated. In this case, the coefficients α_{25}, α_{45} (the contemporaneous effect of net taxes on the interest rate), and α_{46} (the contemporaneous effect of the real exchange rate on the interest rate) were allowed to be

non-zero and the coefficients α_{72} (the contemporaneous direct effect of government purchases on the trade balance), α_{74}, and α_{75} (the contemporaneous direct effect of net taxes on the trade balance) were set to zero. With the exception of the initial effect of the effect of a positive shock to government purchases on net taxes and the initial effect of a negative shock to net taxes on government purchases, the point estimates of the IRFs lay entirely within the confidence intervals for Choleski decomposition.[4]

If fiscal policy is correlated with monetary policy, the results attributed to expansionary fiscal actions may instead reflect expansionary monetary policy actions, which could explain the negative effect of expansionary fiscal shocks on the real interest rate. To check this possibility, we estimated an 8-variable VAR model by adding the federal funds rate to our original model. The ordering considered was *P, G, Y, T, ffr, r, RE, TB* where *ffr* = the federal funds rate. This ordering places *ffr* after the price level, output, and both fiscal variables, but before variables like the long-term interest rate and the exchange rate. The latter variables are expected to respond quickly to monetary policy actions. It thus imposes a lag in the effect of shocks to the federal funds rate on output and price and a lagged response of the fiscal policy variables to innovations in the federal funds rate, which seems reasonable in light of the nature of fiscal policymaking. With the exception of small, transitory deviations for output and the real exchange rate, point estimates of the effects of positive shocks to government purchases are always within or on the confidence intervals for the basic model. There are somewhat bigger differences for the effect of a shock to net taxes. For the real interest rate, the real trade balance, and the price level, there are only small transitory deviations from the confidence intervals for the basic model. For government purchases the point estimates

are always within the confidence intervals until the twenty-fourth quarter, but, unlike the basic model, the point estimate levels off after twelve quarters. The pattern of the point estimate for output is also different from the basic model after eleven quarters, although the point estimate is within the confidence intervals except for small deviations in quarters fifteen through twenty. Adding the federal funds rate has essentially no effects on the patterns or significance of the effects of government purchases shocks, but, for shocks to net taxes, adding the federal funds rate has some effect on the pattern of the point estimates for government purchases and output, although these point estimates are almost always within the confidence intervals.

In the spirit of the government budget constraint that requires that government purchases be financed by a combination of net taxes, government bond sales by the Treasury to the public (deficit finance), and changes in the monetary base, the model was also estimated after adding the real value of the change in the monetary base (*RDMB*) as an additional variable. The deficit was not included as an additional variable in order to conserve degrees of freedom, and, after controlling for the change in the monetary base, the difference between the time paths of government spending and net taxes provides an estimate of the effect on the deficit following a shock to either government spending or net taxes. First, we note that the IRFs and confidence intervals from the 8-variable model (with Choleski ordering *P*, *G*, *Y*, *r*, *T*, *RDMB*, *RE*, *TB*) yield essentially identical results for *P*, *G*, *Y*, *r*, *T*, *RE*, and *TB* to those in the 7-variable model for shocks to both government purchases and net taxes. The only notable difference is that a negative shock to net taxes has a longer-lived, but still transitory, effect on the trade balance. Previous inferences about the effects on output, the price level, the real interest rate, the real

exchange rate, and the trade balance are thus unchanged from the 7-variable model. The IRF for *RDMB* suggests a brief, transitory positive change in the real value of the monetary base following an expansionary fiscal shock, but this effect quickly goes to zero. The initial period positive change in the real value of the monetary base makes the very short-run effects on the budget deficit ambiguous, but, in subsequent periods, the previous inference that expansionary shocks to both government purchases and net taxes have persistent transitory positive effects on the budget deficit hold. Finally, we also note that the point estimates for *P*, *G*, *Y*, *r*, *T*, *RE*, and *TB* from the 8-variable model are always within the confidence intervals for these variables from the 7-variable model.

The robustness of the results was checked in several other dimensions as well. First, alternative long-term interest rates were considered. The 10-year U.S. government bond rate and AAA rate were substituted in turn for the BAA rate. IRFs from VARs containing the government bond rate and the AAA rate generated the same patterns of effects as the model with the BAA rate, and, for the AAA rate, the point estimates were always within the confidence intervals for the model with BAA. For the 10-year government bond rate, the point estimates were within the confidence intervals for the model with BAA for all variables except the real interest rate where there were a few small, transitory breaches of the confidence intervals from the model with the BAA rate.

Second, the sensitivity of the results to replacing the BAA rate with the real ex-post real BAA rate (defined as the difference between the BAA rate and the annualized quarterly inflation rate) in the estimation of the VAR was also examined. In the basic model, the model is estimated with the nominal BAA rate and the real ex-post real rate is generated endogenously as the difference between the IRF for the nominal interest rate

and the annualized quarterly inflation rate implied by the IRF for the price level. In the robustness check, the nominal BAA rate is replaced with the ex-post real rate in the estimation of the model. The point estimates of the IRFs from this model were always found to lie within the confidence intervals for the basic model.

Alternative lag lengths were also considered. The model with the BAA rate was estimated with lags of 3, 5, and 6 quarters. The patterns of the IRFs from the alternative lag length models were essentially the same as for the 4-lag model, and the point estimates of the IRFs were almost always within the confidence intervals for the 4-lag model. The infrequent deviations from the confidence intervals were minor, although the pattern of response of the real interest rate for a shock to net taxes in the 6-lag model is erratic. However, the results are not affected in any significant way by considering alternative lag lengths.

The 4-lag BAA model was also estimated with the current and 4 lagged values of the log of the real price of oil (producer price index for crude oil/chained price index for GDP) added as deterministic variables in every equation of the VAR. With only one minor exception for the real interest rate for a shock to net taxes, the point estimates of the IRFs for this model were always on or within the confidence intervals for the basic model. The same was found when the model was estimated when only the current real price of oil was added to the model.

Additional robustness tests included the following.

(a) The current and 4 lagged values of a 9/11 dummy (value of 1 in 2001:3 and 0 elsewhere) were added as deterministic variables in every equation of the VAR. The point estimates of the IRFs for this model were almost always within the confidence

intervals for the basic model, and the few departures from the confidence intervals were minor.

(b) Although all the data except for the interest rate and the exchange rate are seasonally adjusted, seasonal dummies were added, and the point estimates of the IRFs for the model with seasonal dummies were almost always within the confidence intervals for the basic model, and the deviations were very small and transitory.

(c) The basic model includes total government purchases which is the sum of government consumption and investment. In order to determine if consumption and investment spending had different effects on the macroeconomy, the model was also estimated first with government consumption replacing total government purchases and then a second time with government investment replacing total government purchases. The other variables were the same as in the basic model. In both cases, the point estimates of the IRFs for output, the price level, the real interest rate, the real exchange rate and the real trade balance for shocks to government consumption and investment were, with rare and transitory exceptions, within the confidence intervals for the basic model.[5]

(d) The real exchange rate measure used to this point is the broad index of the real trade weighted exchange rate developed by the Federal Reserve. It is a geometrically weighted average of the bilateral exchange rates of twenty-six countries that account for over 90 percent of total U.S. imports and exports (Loretan (2005)). The sensitivity of the results to this measure of the real exchange rate was checked by estimating the basic model using the real value of the major currencies index developed by the Federal Reserve. This index focuses on seven of the twenty six currencies in the broad index (the euro, Canadian dollar, Japanese yen, British pound, Swiss franc, Australian dollar, and

Swedish krona). The point estimates from the model with the major currencies index were always within the confidence intervals from the model estimated with the broad index.

5. Summary and Conclusion

We examined the effects of expansionary fiscal policy shocks on macroeconomic activity within a seven-variable VAR model. The empirical findings in this paper indicate that, contrary to common perception, there is no link between expansionary fiscal policies and trade deficits. Expansionary fiscal policy shocks which lead to a significant depreciation of the real exchange rate also generate a significant improvement in the trade balance.

Our findings indicate that there is a transitory increase in output, a long-lived increase in the price level, a persistent decrease in the real interest rate, a long-lived depreciation of the exchange rate, and a long-lived improvement in the trade balance in response to an expansionary shock to government purchases.

The finding on output and the price level is expected. However, the response of the real interest rate, the real exchange rate, and the trade balance is surprising. These results run counter to the conventional wisdom that expansionary fiscal policy raises the real interest rate, leads to an appreciation of the real exchange rate, and thereby precipitates deterioration in the trade balance. The crucial link in this chain of reasoning is the response of the real interest rate. In many theoretical studies the real interest rate rises following an increase in government purchases. An increase in the real interest rate is associated with an appreciation of the real exchange rate, which is related to the deterioration of the trade balance. What we find is just the opposite. The real interest

rate declines significantly in response to an unanticipated increase in government purchases. The fall in the real interest rate is consistent with the depreciation of the real exchange rate and hence with the improvement of the trade balance. As mentioned earlier, the fall in the real interest rate is consistent with a model based on dynamic optimization with price rigidities or a general equilibrium model with durable and nondurable consumer goods and productive capital.

As expected, we also find that both output and the price level rise in response to a negative innovation in net taxes. There is a significant positive effect on the price level that lasts about four years, but the response of output is significant for only a few quarters after a long lag. There are essentially no significant effects on the real interest rate, the real exchange rate, ant the trade balance. The macroeconomic effects of expansionary net tax shocks are thus much weaker than the effects of expansionary shocks to government purchases.

Endnotes

1. Using closed-economy VARs, Ramey and Shapiro (1998), Edelberg, Eichenbaum, and Fisher (1999), Yuan and Li (2000), Fatas and Mihov (2001), and Gali, Lopez-Salido, and Valles (2004) examine the dynamic response of the economy to government spending shocks. Blanchard and Perotti (2002), Perotti (2002), De Arcangelis and Lamartina (2003), and van Aarle, Garretsen, and Gobbin (2003) investigate the effects of shocks to taxes and government spending on the economy.

2. Although it is not uncommon to test for unit roots among variables and then, based on the results of these tests, perhaps for cointegration, the power of unit root tests to distinguish between a unit root and a near unit-root process is not high. As noted by Hamilton (1994), estimating a VAR in levels yields consistent estimates even if the variables have a unit root. If the variables do not have a unit root, differencing is not appropriate since it imposes an invalid restriction. Hamilton also notes that a VAR estimated in differences is not appropriate if there is cointegration among the variables, but a VAR estimated in levels can be consistent with a cointegrated system.

3. The CVMODEL routine in RATS with pmethod set to Genetic and method set to BFGS was used to estimate the elements of A_0. The starting values for all parameters except for α_{25} were set to the Choleski estimates of these parameters. The Choleski estimates of the alpha parameters are found by first regressing the residual from equation two on the residual from equation one (α_{21}), the residual from equation three on the residuals from equations one and two, and so on. The starting value for α_{25}, which, of course, is not estimated in our Choleski decomposition, was set to 0.1.

4. The same estimation procedure was used and the starting values for α_{25}, α_{45}, and α_{46} were all set to 0.1.

5. The point estimate of the own effect for a shock to real government investment purchases was outside the confidence interval for the basic model with total government purchases, so it does seem to be the case that the magnitude and persistence of the own effect for investment differs significantly from total government purchases. This is not, however, the case for the own effect for a shock to government consumption purchases which was within the confidence interval for the basic model in all but one quarter. There was a very small breach in this quarter. The response of government investment to a shock to net taxes had the same general pattern as the basic model, but fell below the lower confidence interval for periods four through ten. The pattern of response of government consumption to a shock to net taxes was different from the basic model, and the point estimate lay outside the basic model confidence interval in periods five through twelve.

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TABLE 1
Definitions and Data Sources for the Variables Used*

real gdp (gdpr) : billions chained 2000 $,saar, Global Insight US Central database.

real government purchases = real total government consumption + gross investment (gr): billions chained 2000 $,saar. Global Insight US Central database.

price level = GDP price index (jpgdp):, chained, 2000=100,saar, Global Insight US Central database.

BAA corporate bond rate (fybaac): Global Insight U.S. Basic database.

AAA corporate bond rate (fyaaac): Global Insight U.S. Basic database.

10-year federal govnt bond rate (fygt10): Global Insight U.S. Basic database.

producer price index crude oil (PW561): Global Insight U.S. Basic database.

real exports of goods & services (xr): billions chained 2000 $,saar, Global Insight US Central database.

real imports of goods & services (mr): billions chained 2000 $,saar, Global Insight US Central database.

nominal total government net taxes: $billions, saar, constructed as total government receipts (grcptc) – gtransfers. grcptc Global Insight US Central database.

real government net taxes = nominal government net taxes/GDP price index

nominal total government transfers (gtransfers): $billions, saar, constructed as total government current expenditures (gexpc) - total government consumption (gc).

nominal total government current expenditures, (gexpc): $billions, saar, Global Insight US Central database.

nominal total government consumption expenditures (gc): $billions, saar, Global Insight US Central database.

real trade weighted exchange rate, broad index (rtwexb): Board of Governors of the Federal Reserve web site. Geometrically weighted average of bilateral exchange rates for twenty six countries. See Loretan (2005) for a list of these countries.

real trade weighted exchange rate, major currencies index (rtwexmc): Board of Governors of the Federal Reserve web site. Geometrically weighted average of bilateral exchange rates for seven countries. See Loretan (2005) for a list of these countries.

nominal monetary base (not adjusted for reserve requirements) : FRED data base, Federal Reserve Bank of St. Louis web site, seasonally adjusted using X11 in RATS 6.30

real value of change in monetary base: change in monetary base/GDP price index

*saar = seasonally-adjusted annual rate

Figure 1

Positive Shock to Real Government Purchases

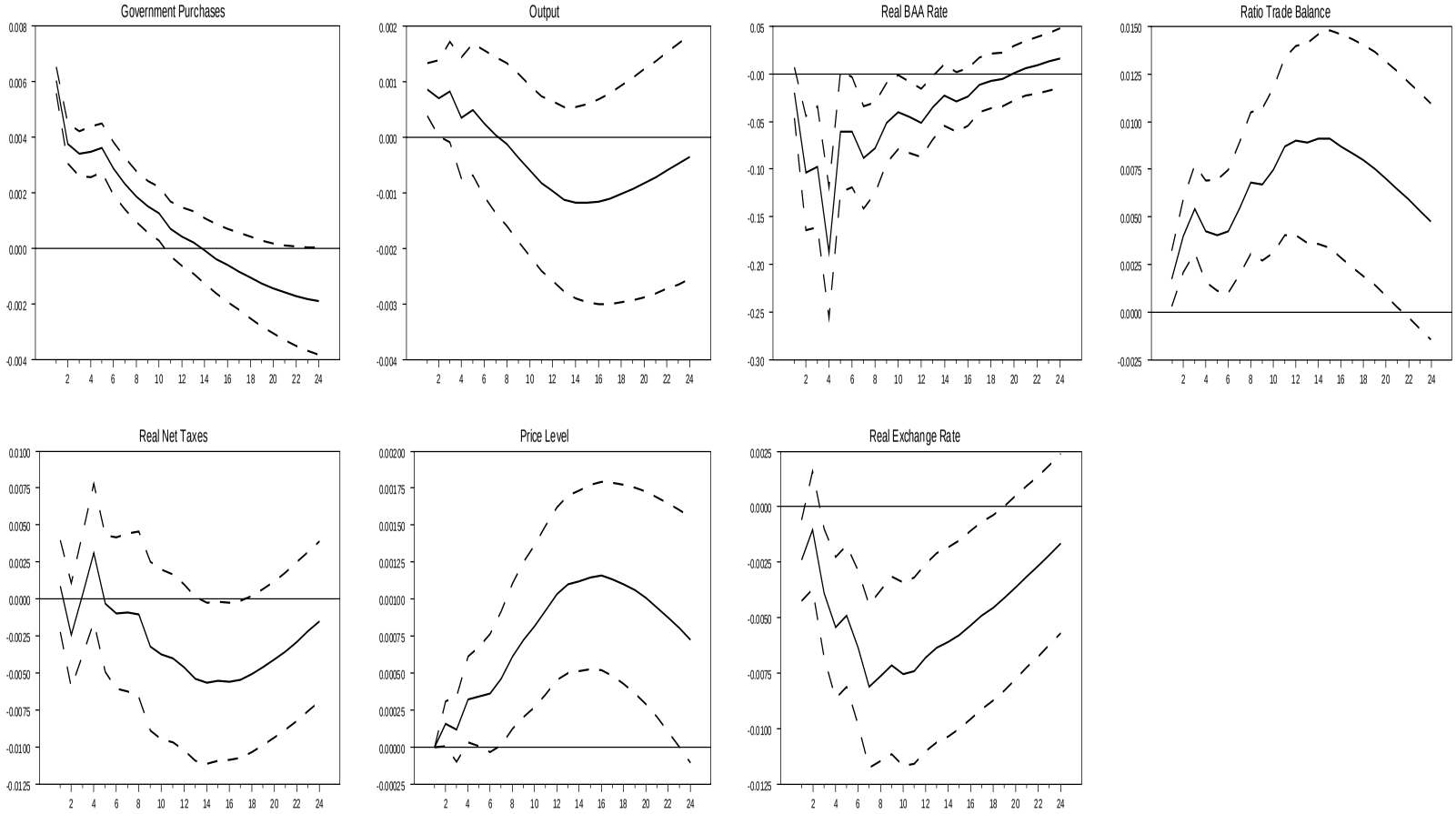
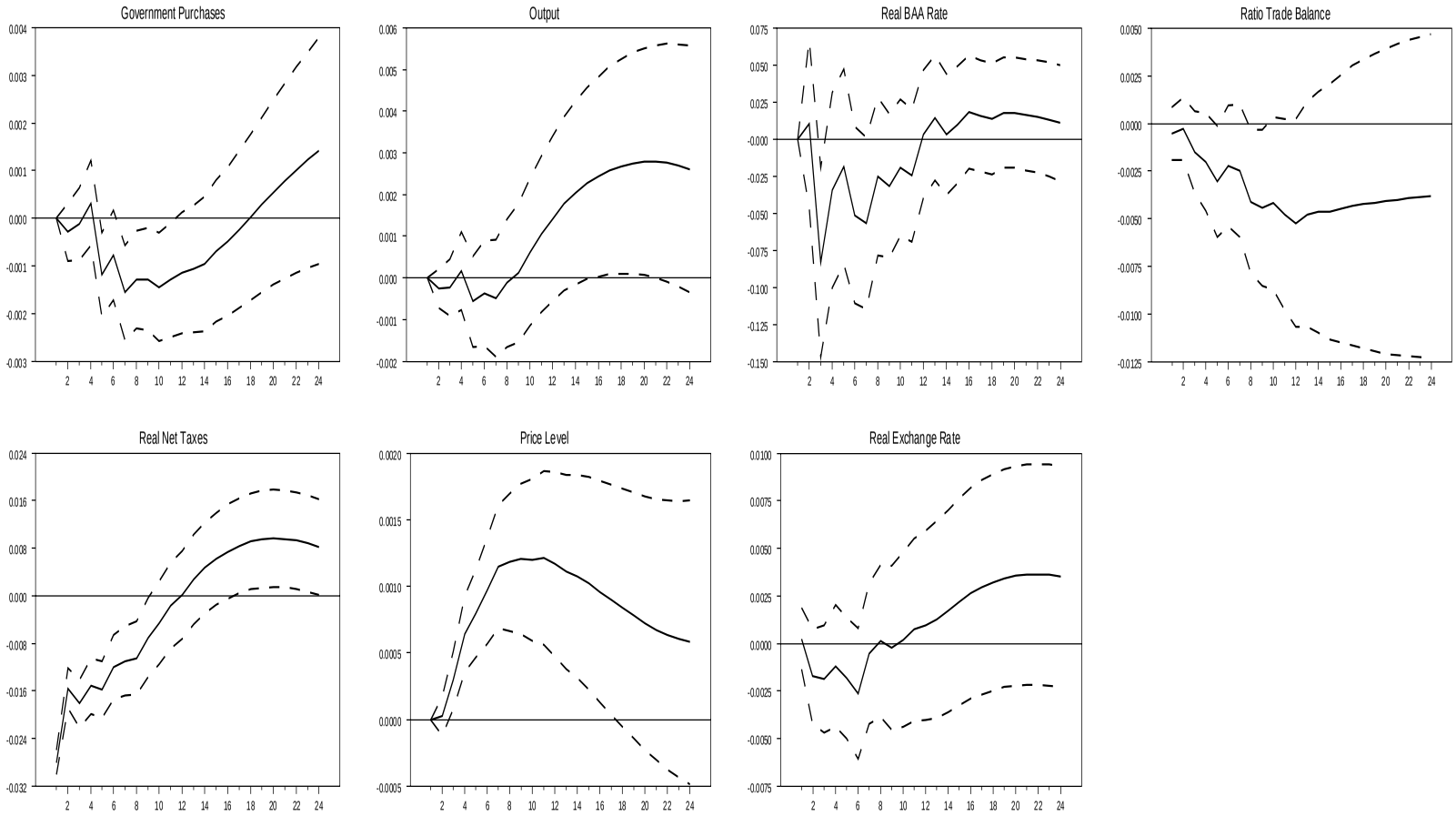


Figure 2

Negative Shock to Real Government Net Taxes



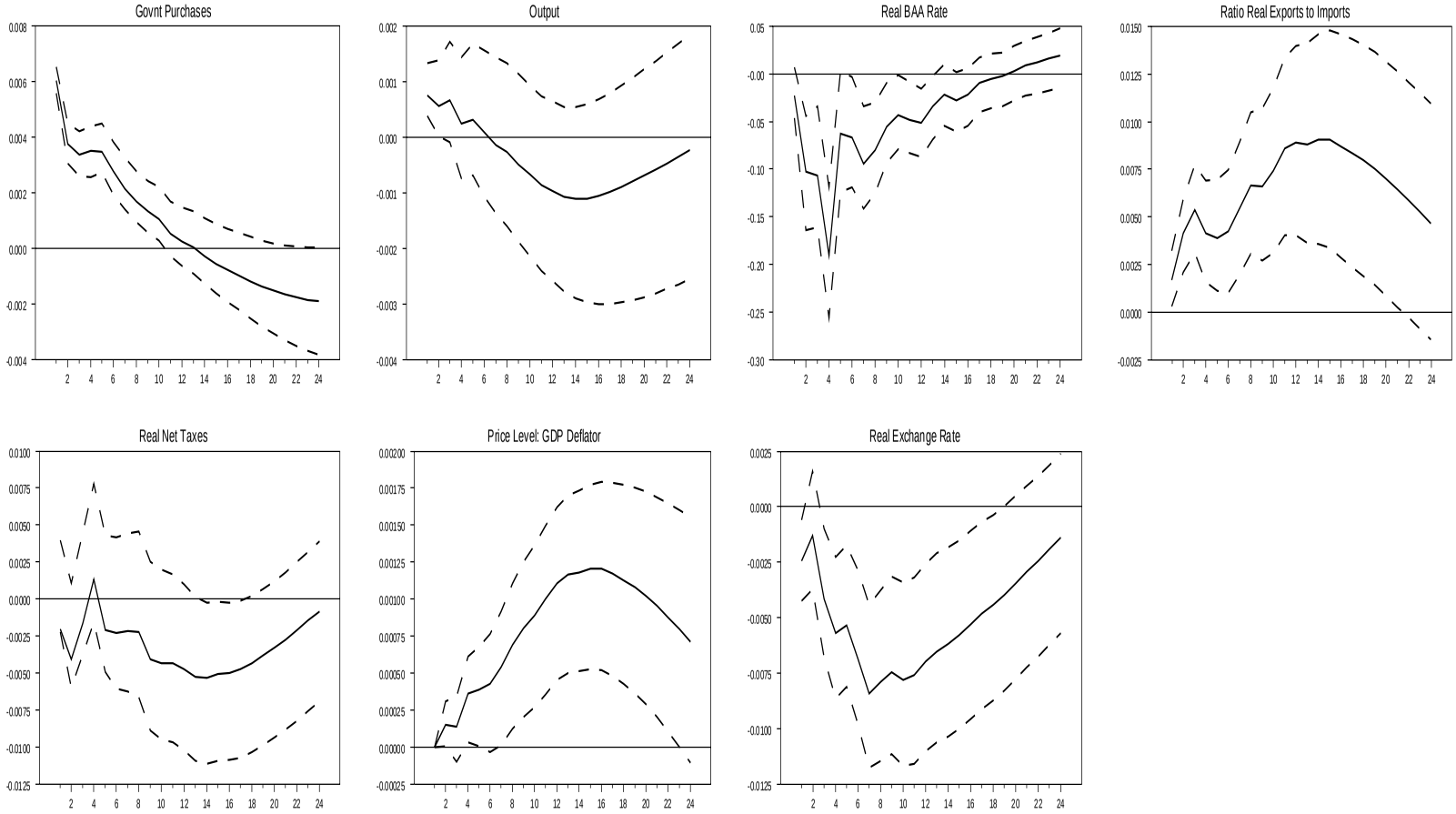
Appendix to

FISCAL SHOCKS, THE TRADE BALANCE, AND THE EXCHANGE RATE

May 2007

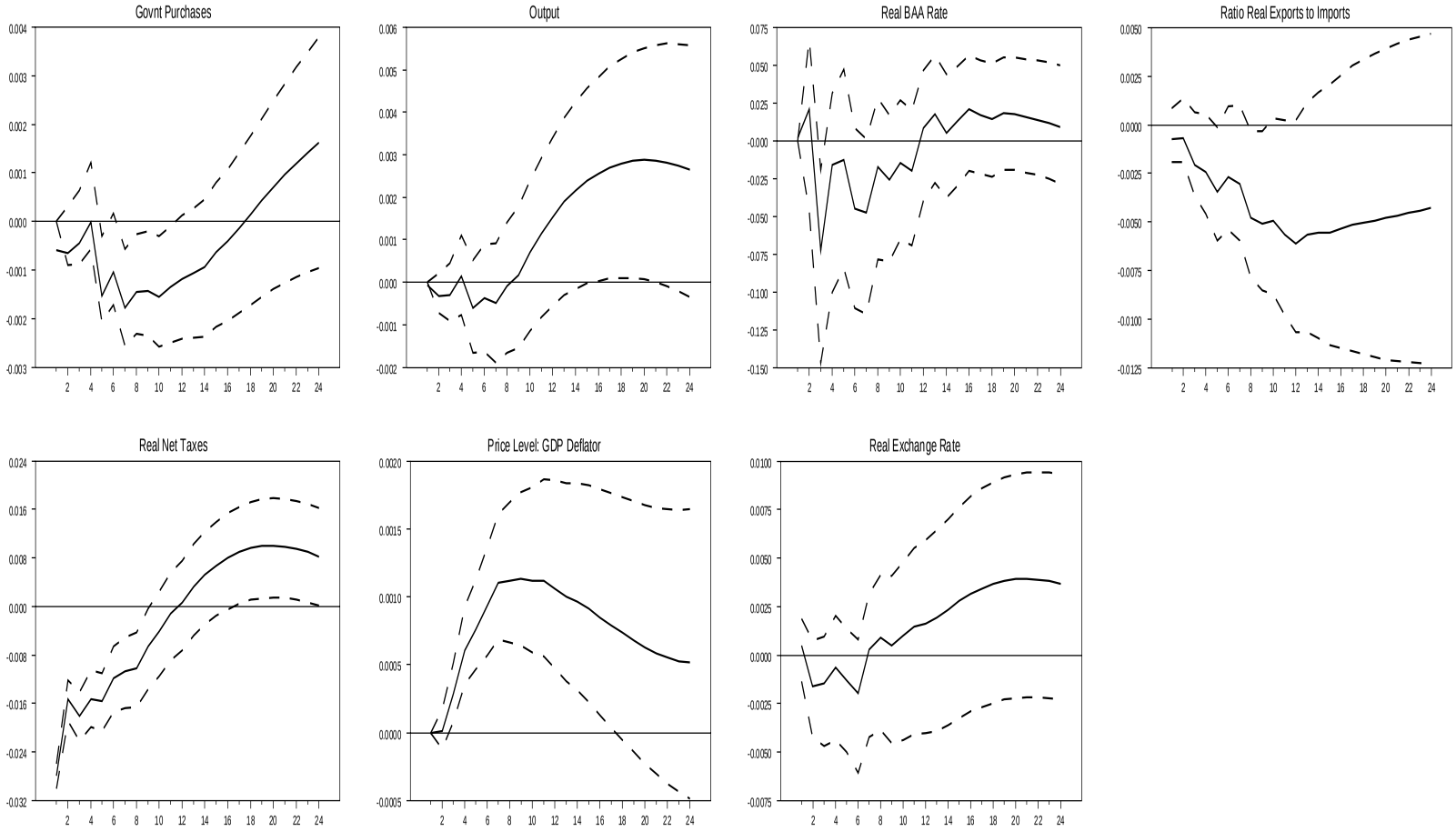
Appendix Figure 1: Effects of a Positive Shock to Real Government Purchases

Structural Model No. 1



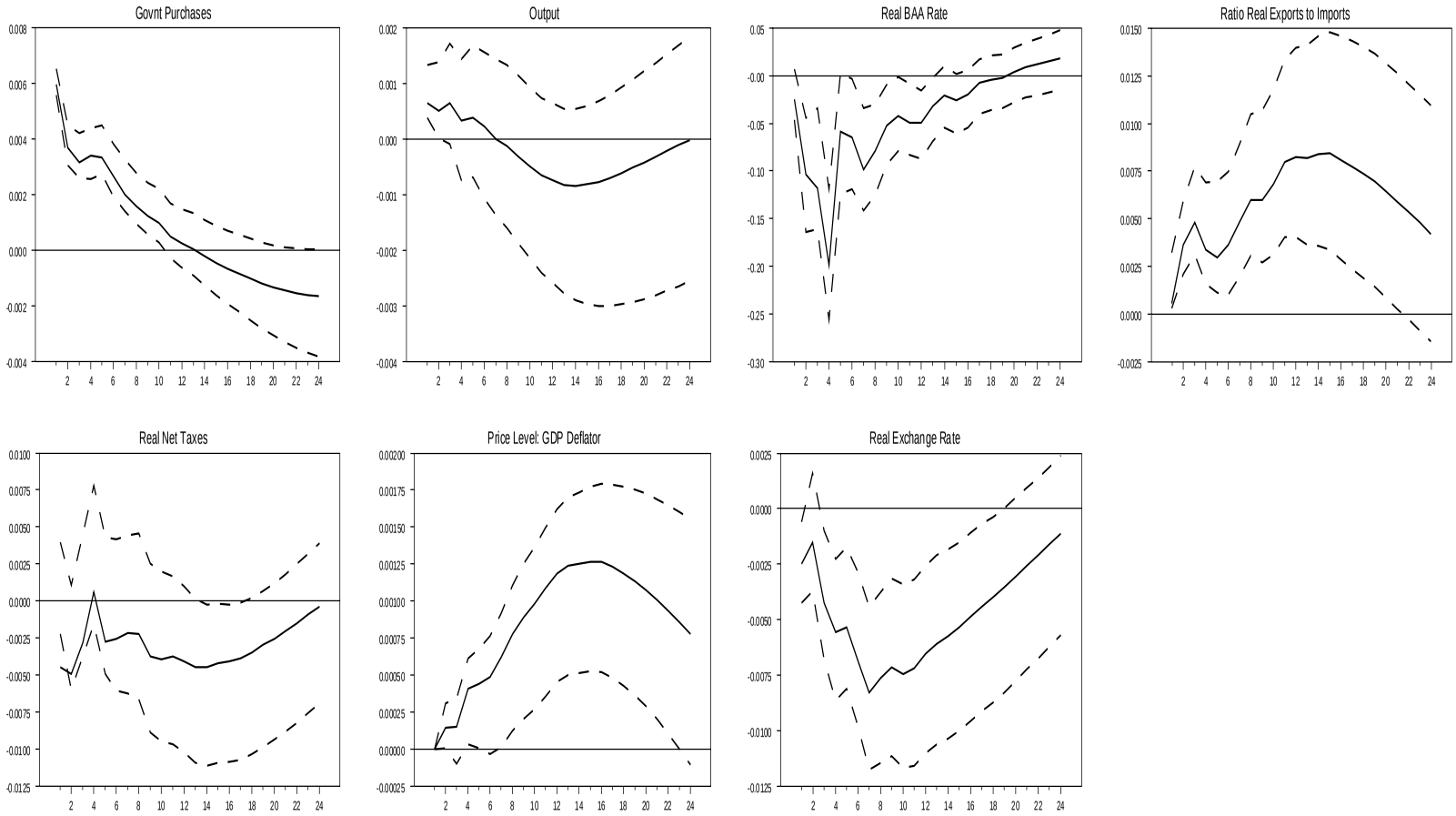
Appendix Figure 2: Effects of a Negative Shock to Real Net Taxes

Structural Model No. 1



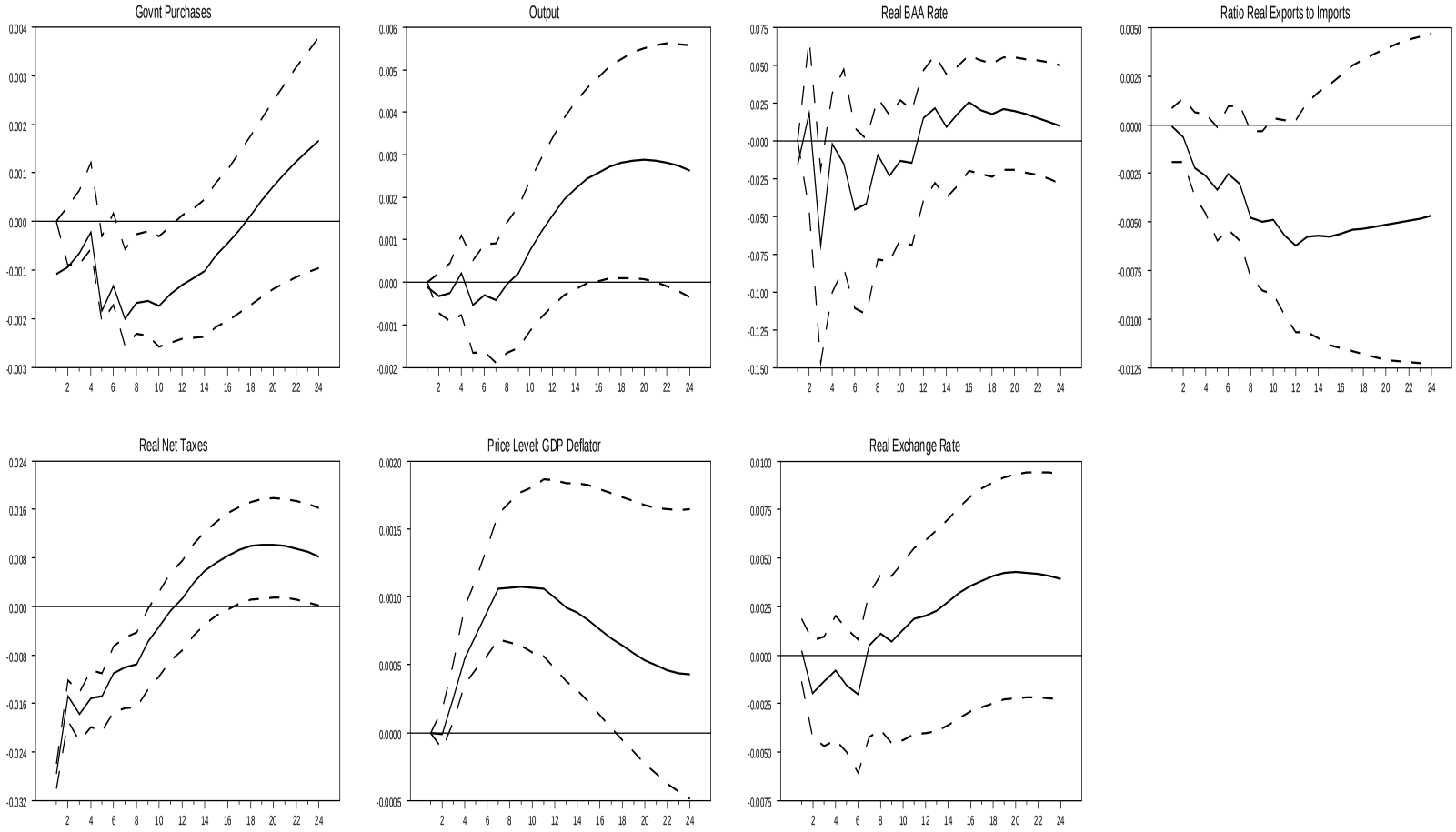
Appendix Figure 3: Effects of a Positive Shock to Real Government Purchases

Structural Model No. 2



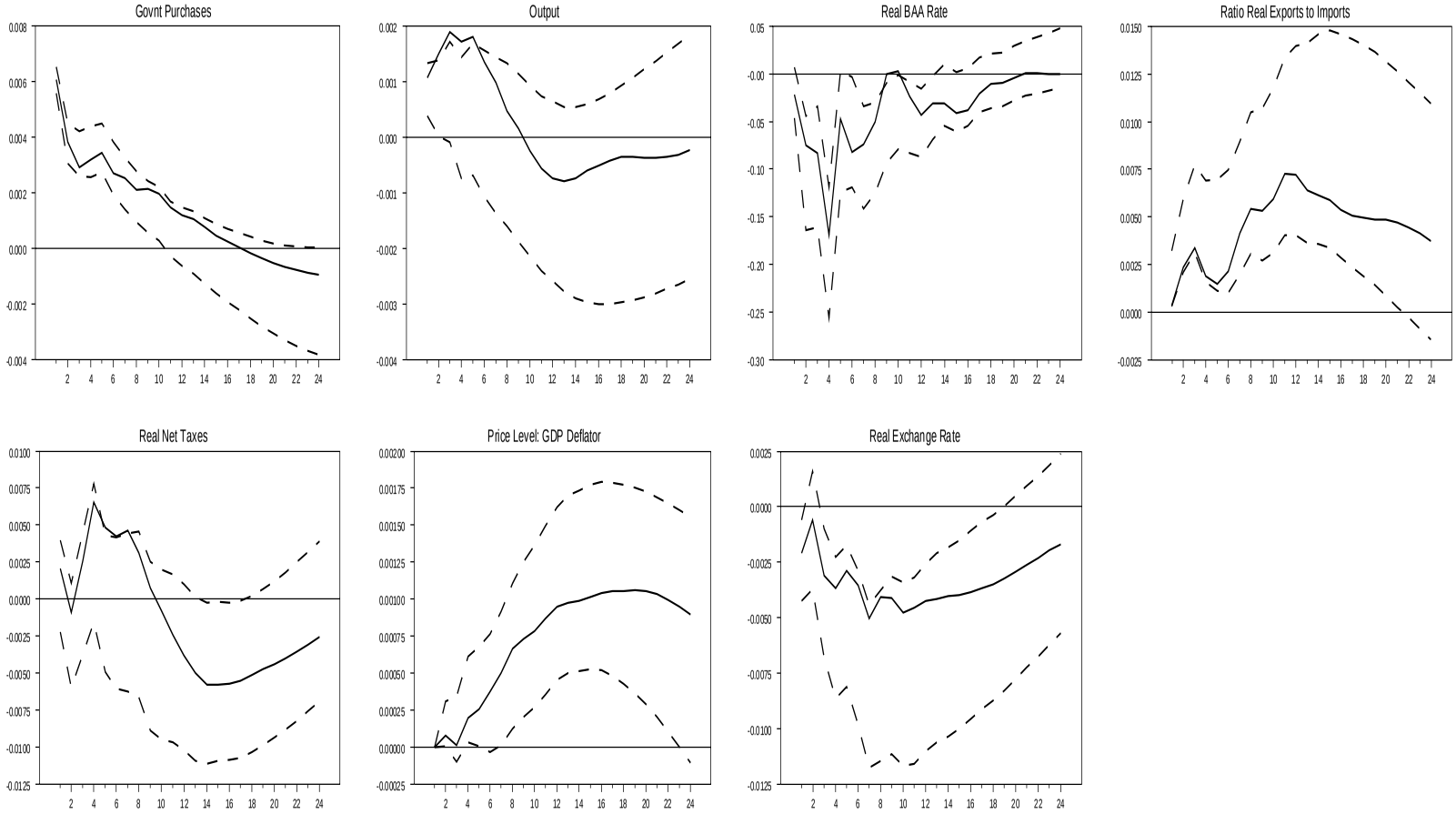
Appendix Figure 4: Effects of a Negative Shock to Real Net Taxes

Structural Model No. 2



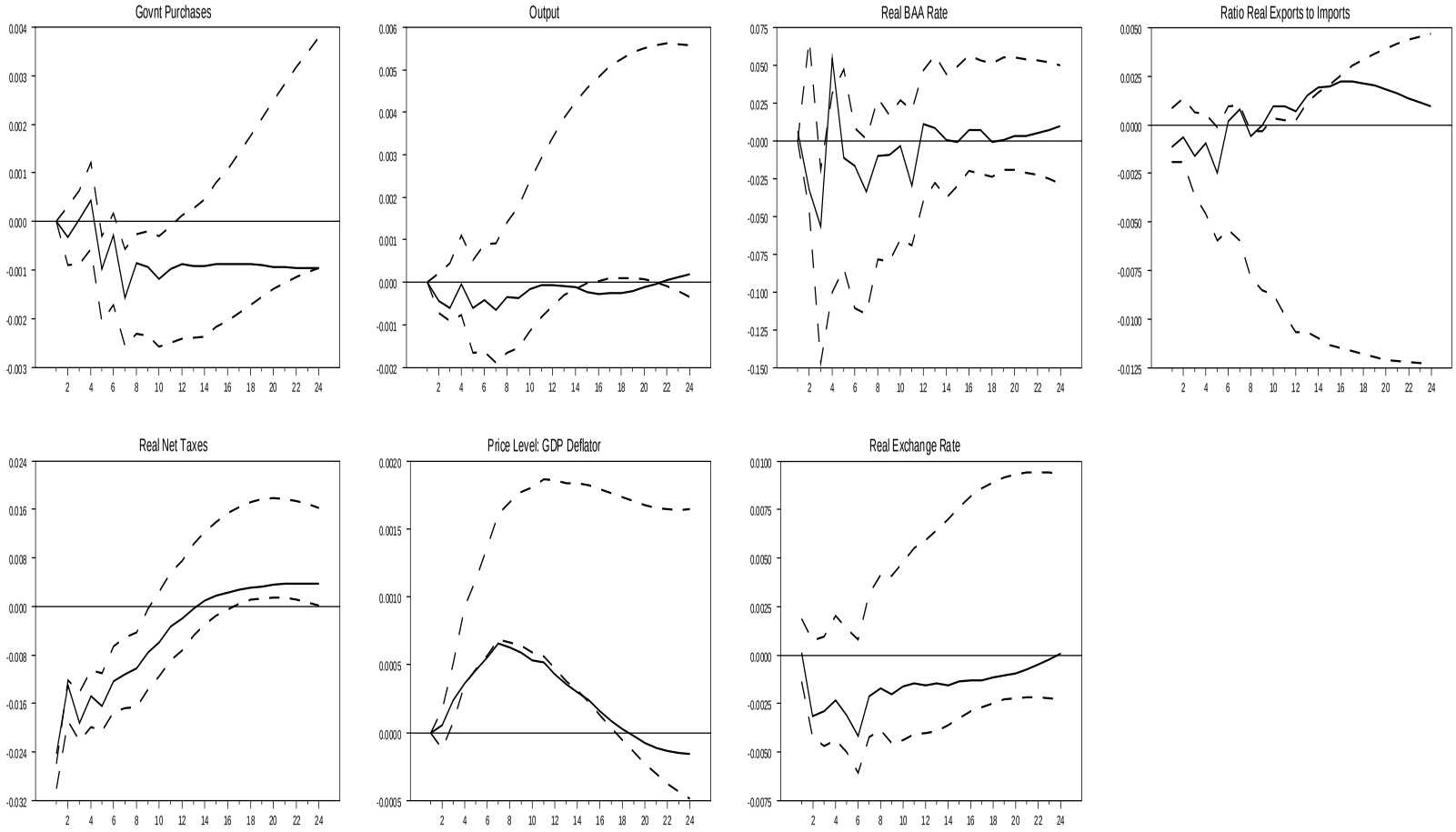
Appendix Figure 5: Positive Shock to Real Government Purchases

Eight Variable Model with Fed Funds Rate



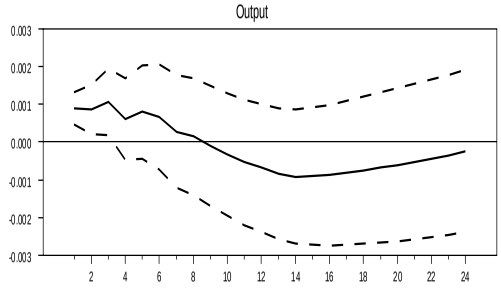
Appendix Figure 6: Negative Shock to Real Net Taxes

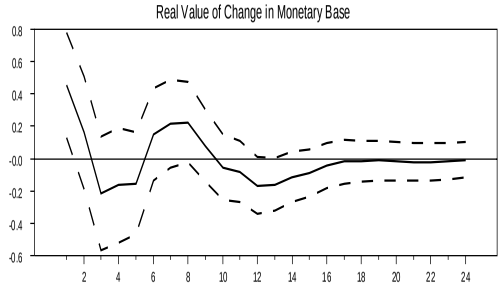
Eight Variable Model with Fed Funds Rate

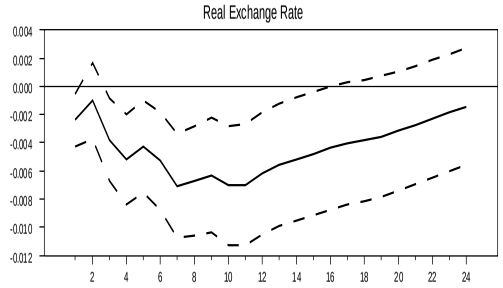


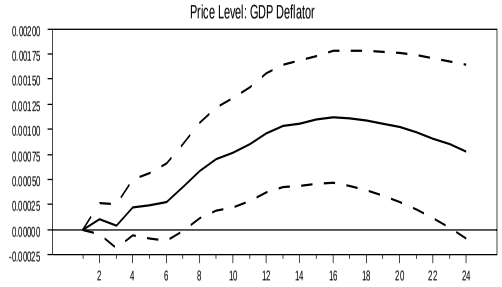
Appendix Figure 7a: Positive Shock to Real Govnt Purchases

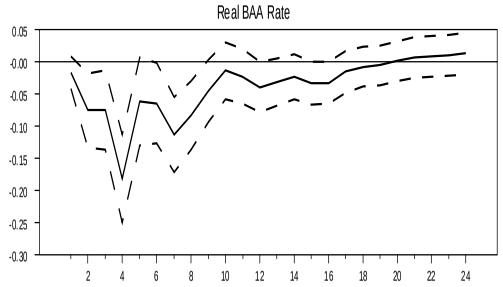
8 Variable Model w/Change in Real Monetary Base and Confidence Intervals from this Model

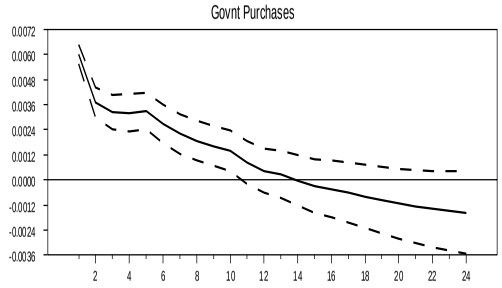


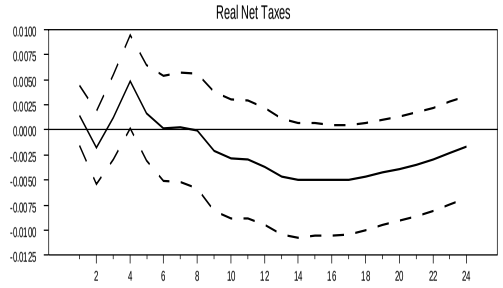






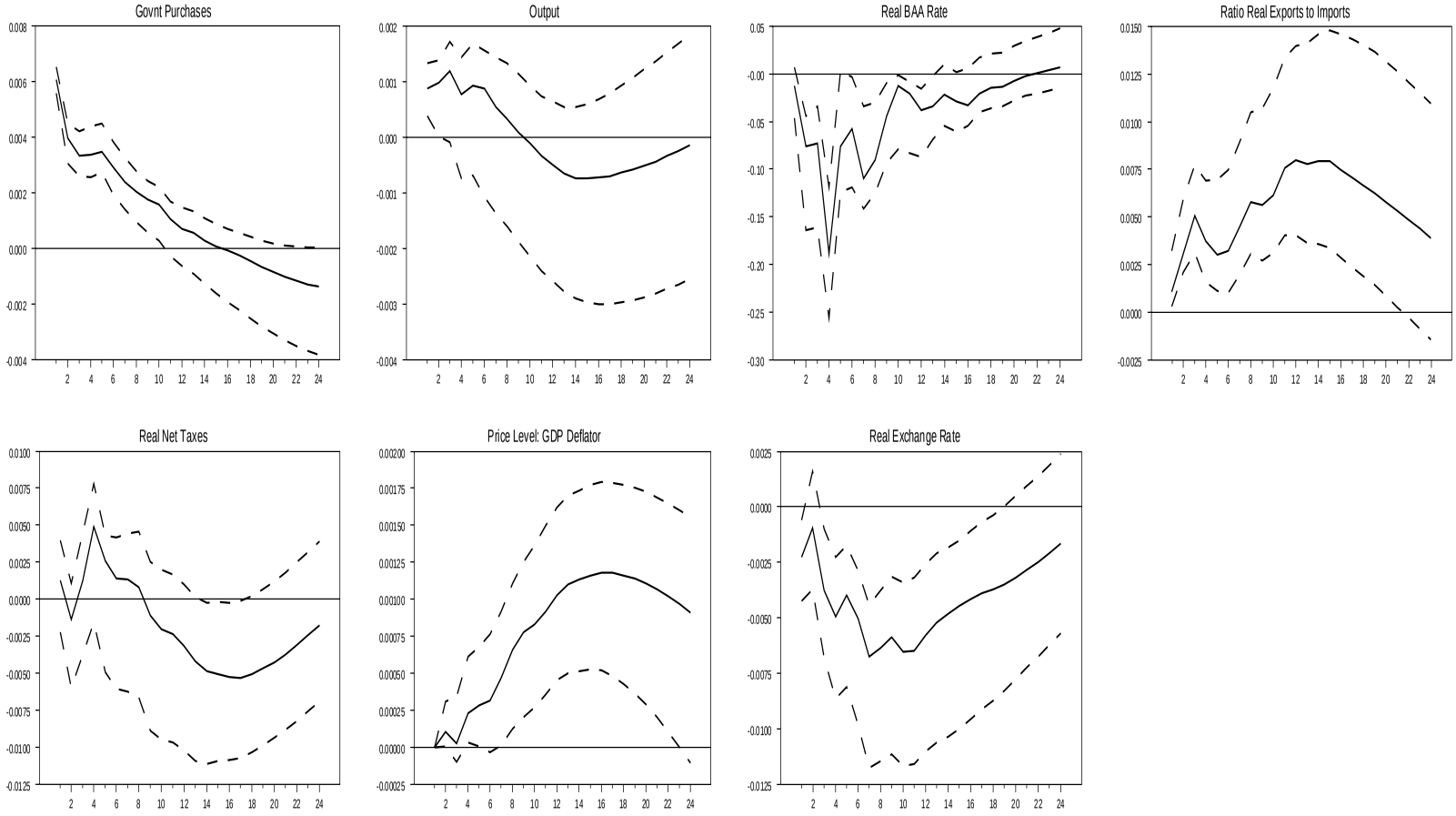






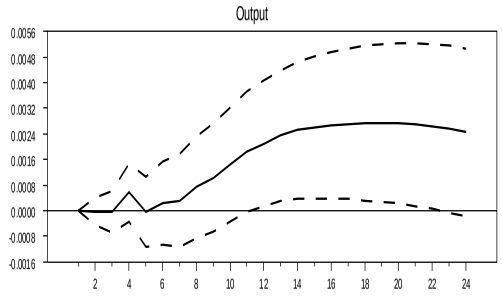
Appendix Figure 7b: Positive Shock to Real Government Purchases

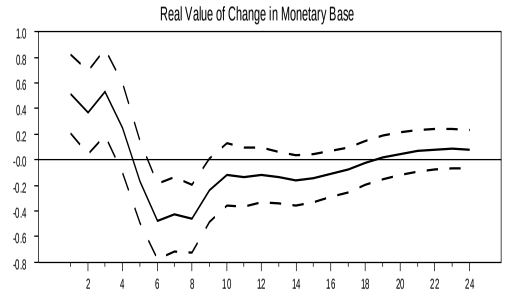
8 Variable Model w/Change in Real Monetary Base & Confidence Intervals from 7-Variable Model

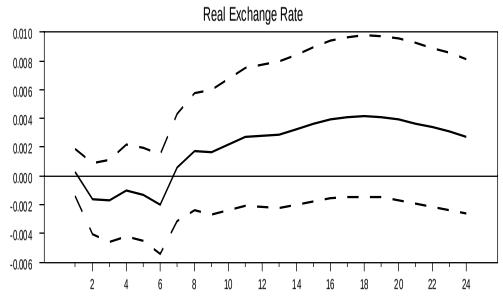


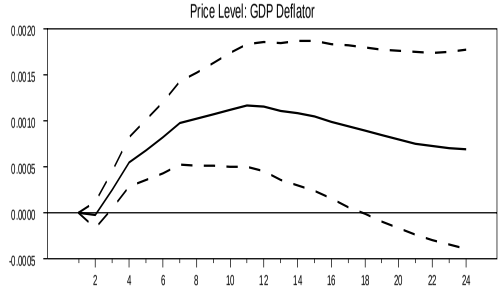
Appendix Figure 8a: Negative Shock to Real Net Taxes

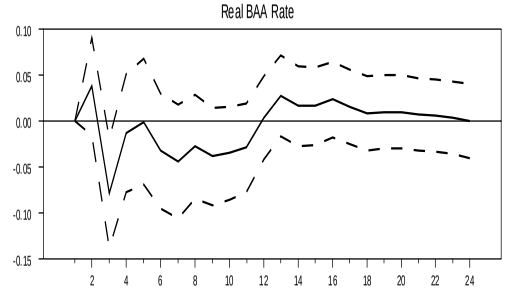
8 Variable Model w/Change in Real Monetary Base and Confidence Intervals from this Model

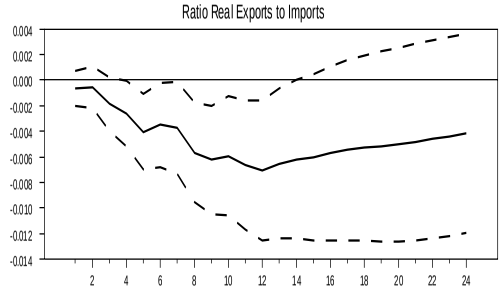


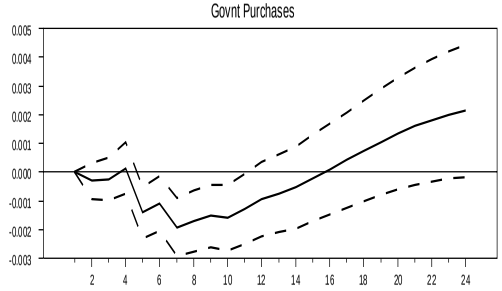


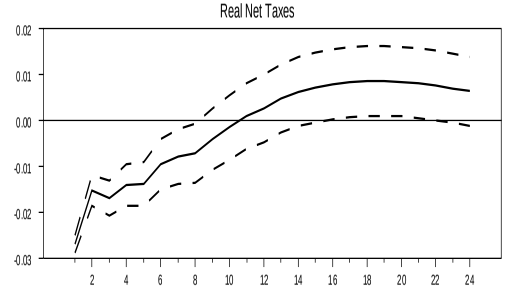






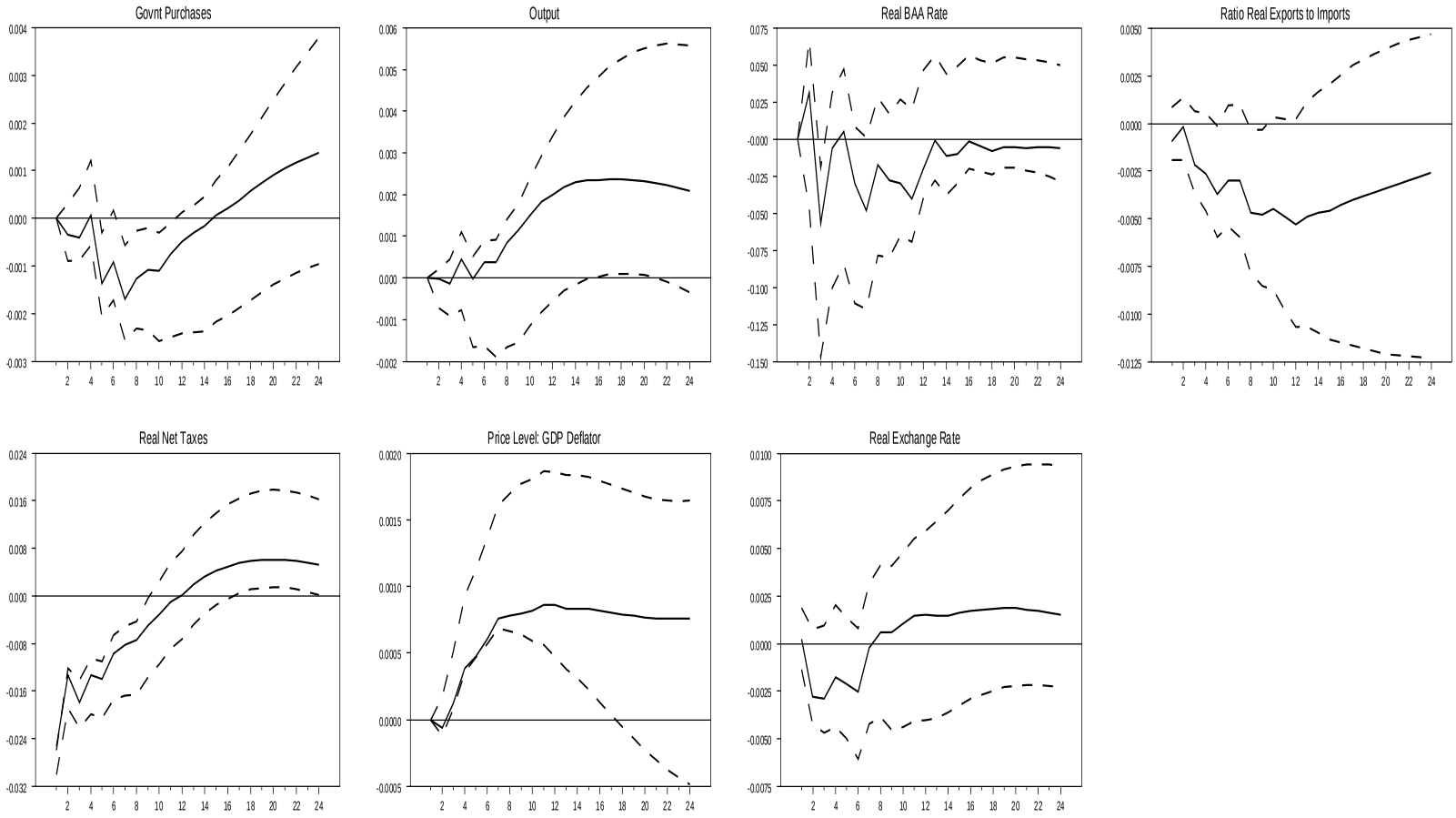






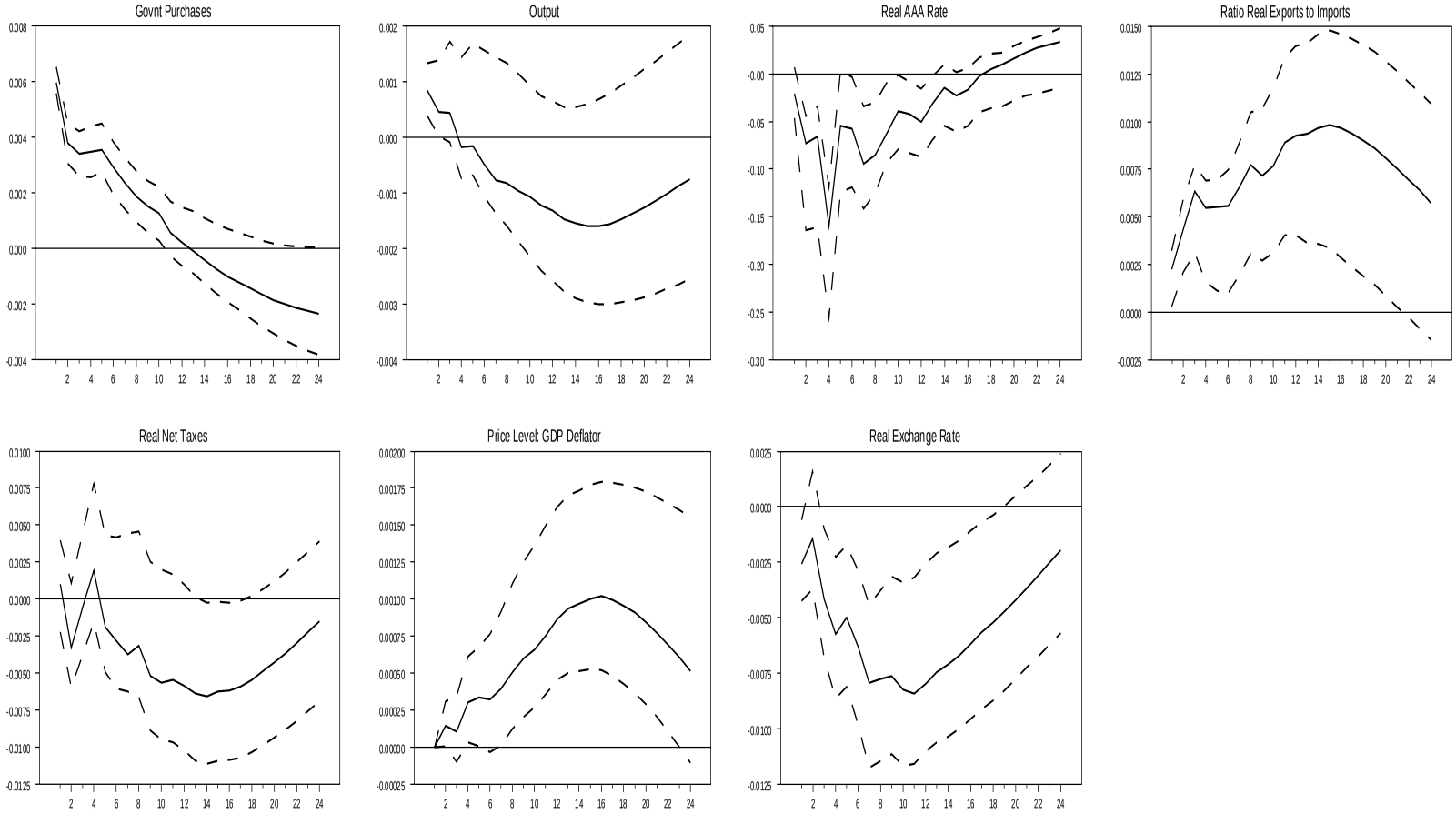
Appendix Figure 8b: Negative Shock to Real Net Taxes

8 Variable Model w/Change in Real Monetary Base & Confidence Intervals from 7-Variable Model



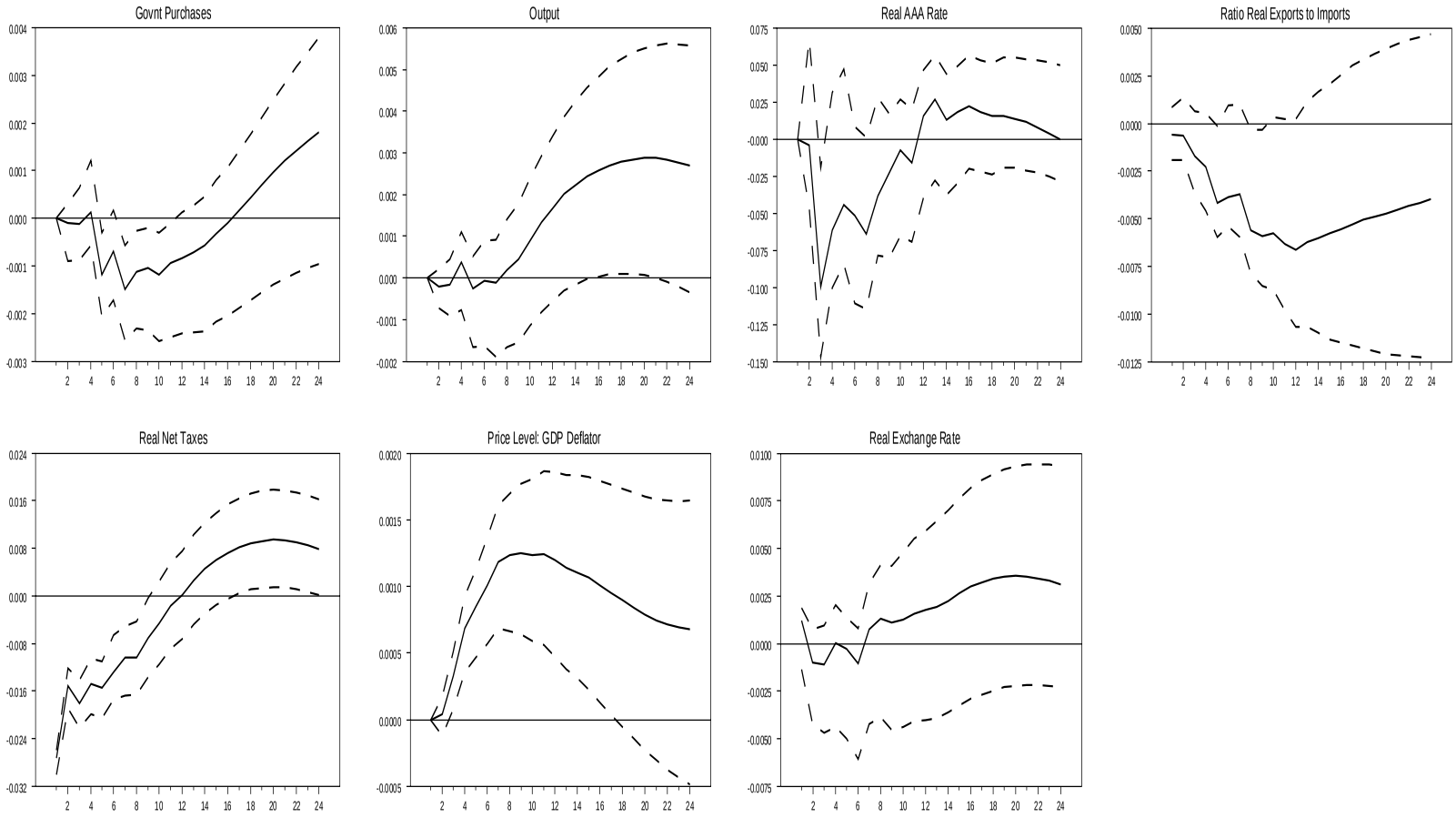
Appendix Figure 9: Positive Shock to Real Govnt Purchases

Point Estimates for System with AAA Rate & Confidence Intervals for System with BAA Rate



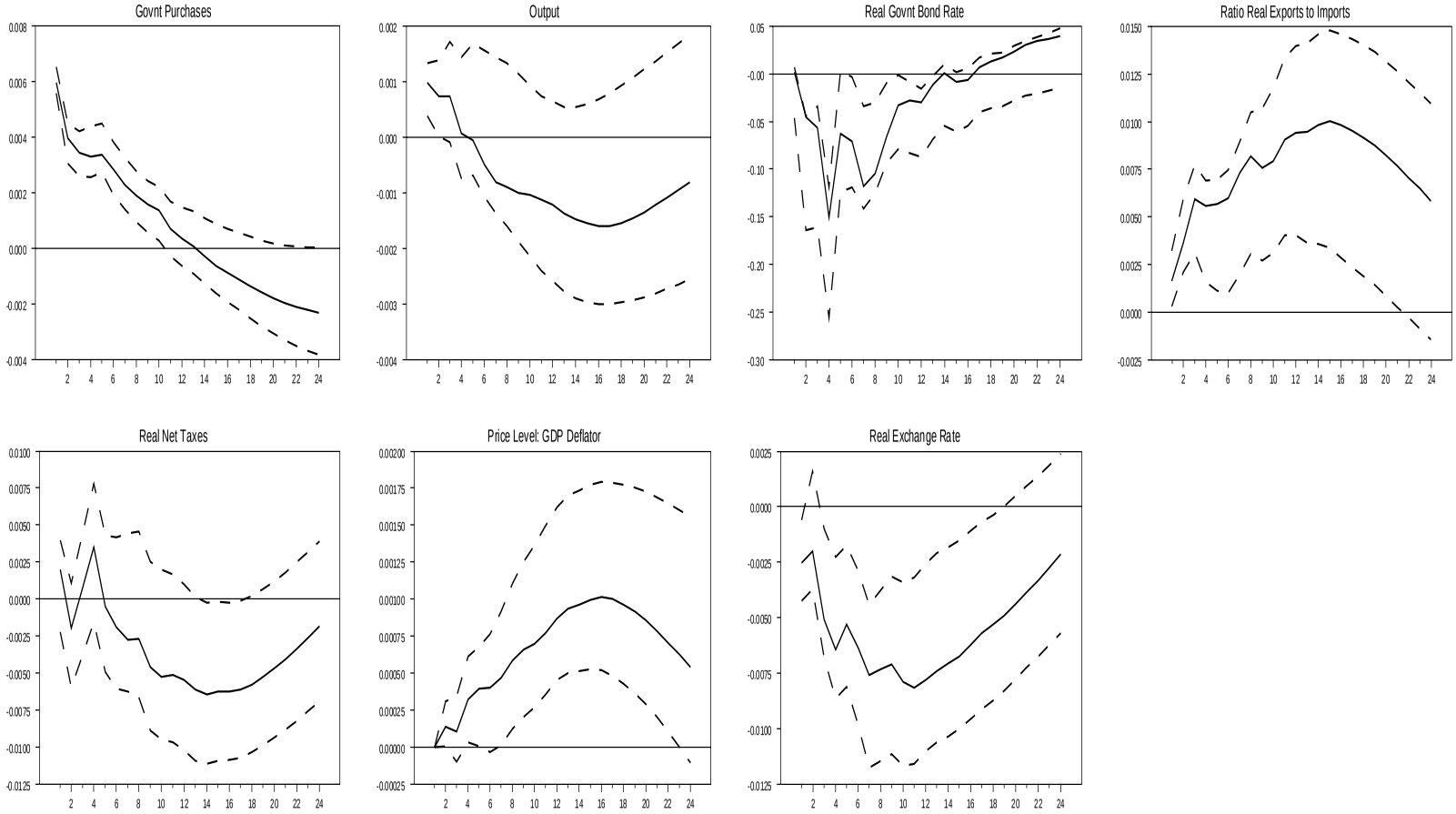
Appendix Figure 10: Negative Shock to Real Net Taxes

Point Estimates for System with AAA Rate & Confidence Intervals for System with BAA Rate



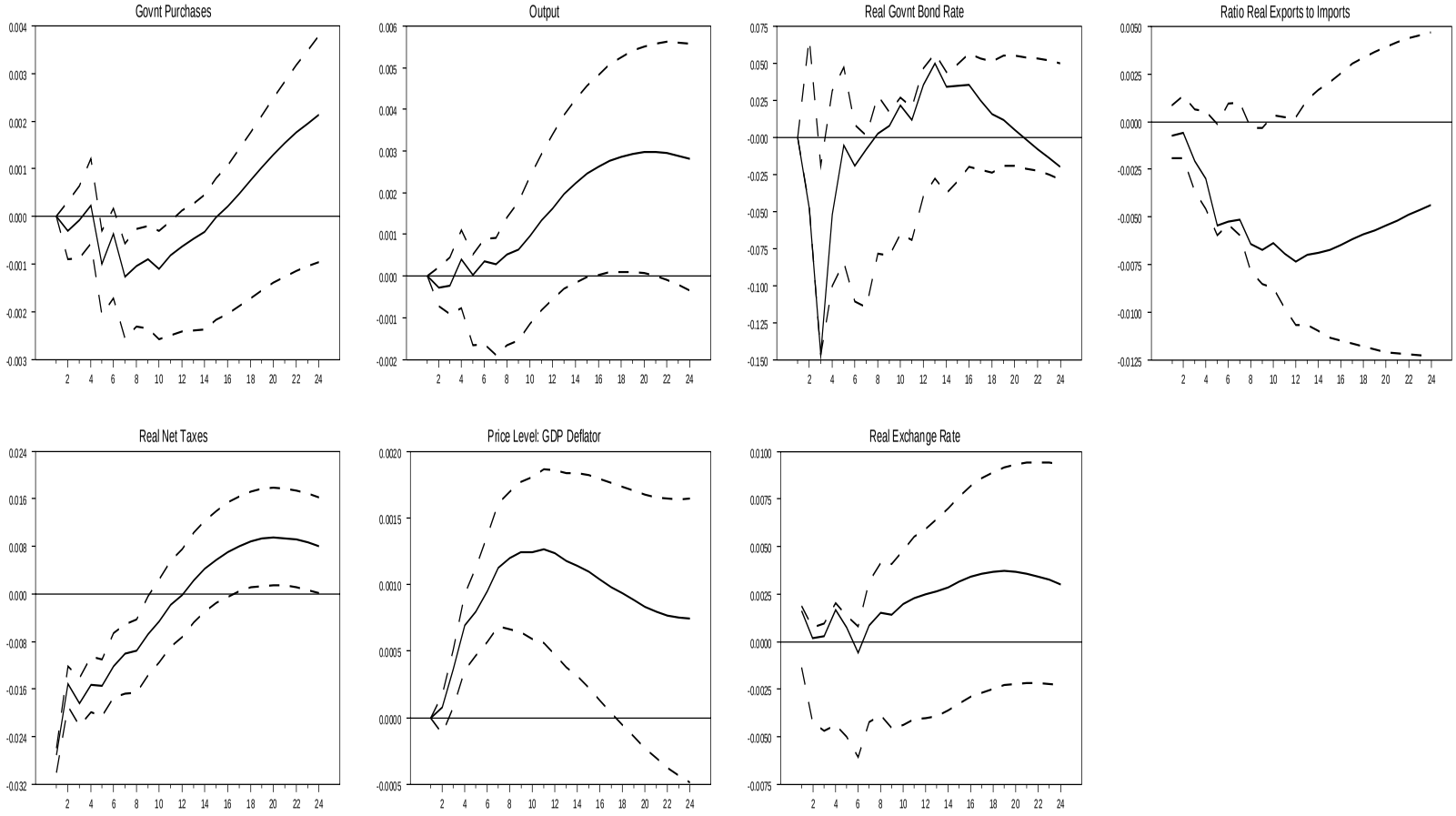
Appendix Figure 11: Positive Shock to Real Govnt Purchases

Point Estimates for System with Long-Term Govnt Bond Rate & Confidence Intervals for System with BAA Rate



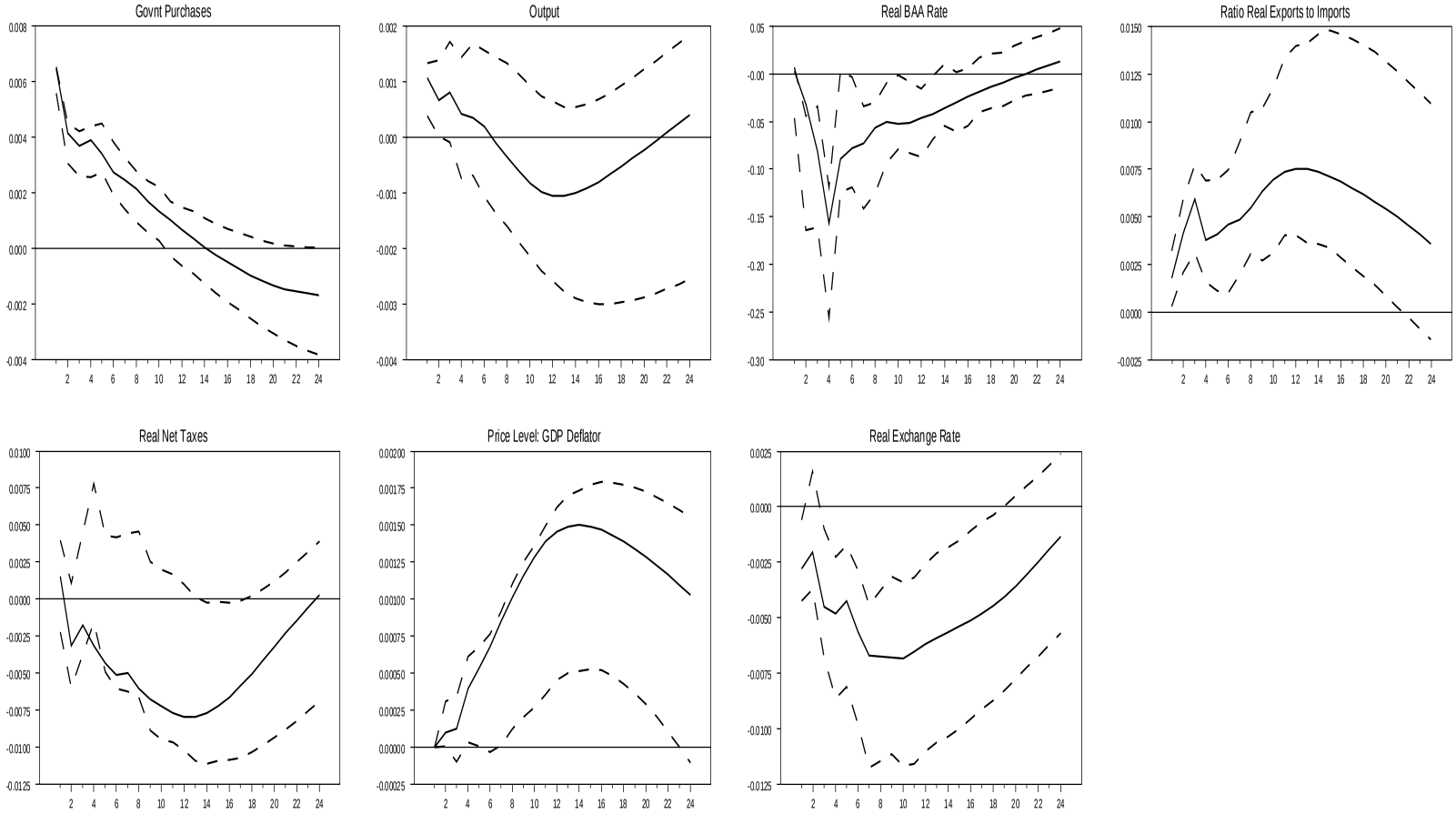
Appendix Figure 12: Negative Shock to Real Net Taxes

Point Estimates for System with Long-Term Govnt Bond Rate & Confidence Intervals for System with BAA Rate



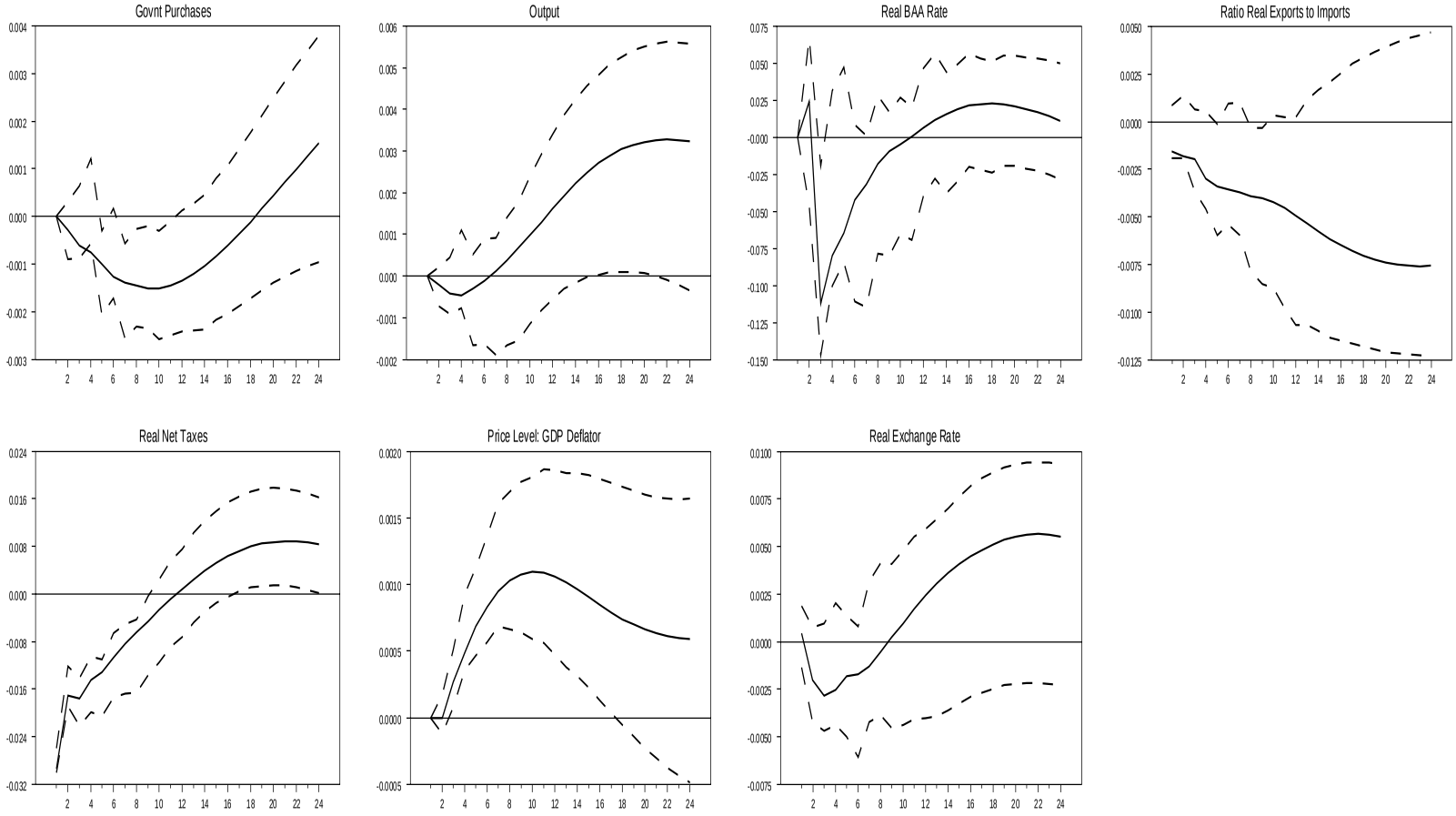
Appendix Figure 13: Positive Shock to Real Govnt Purchases

Model with 3 lags



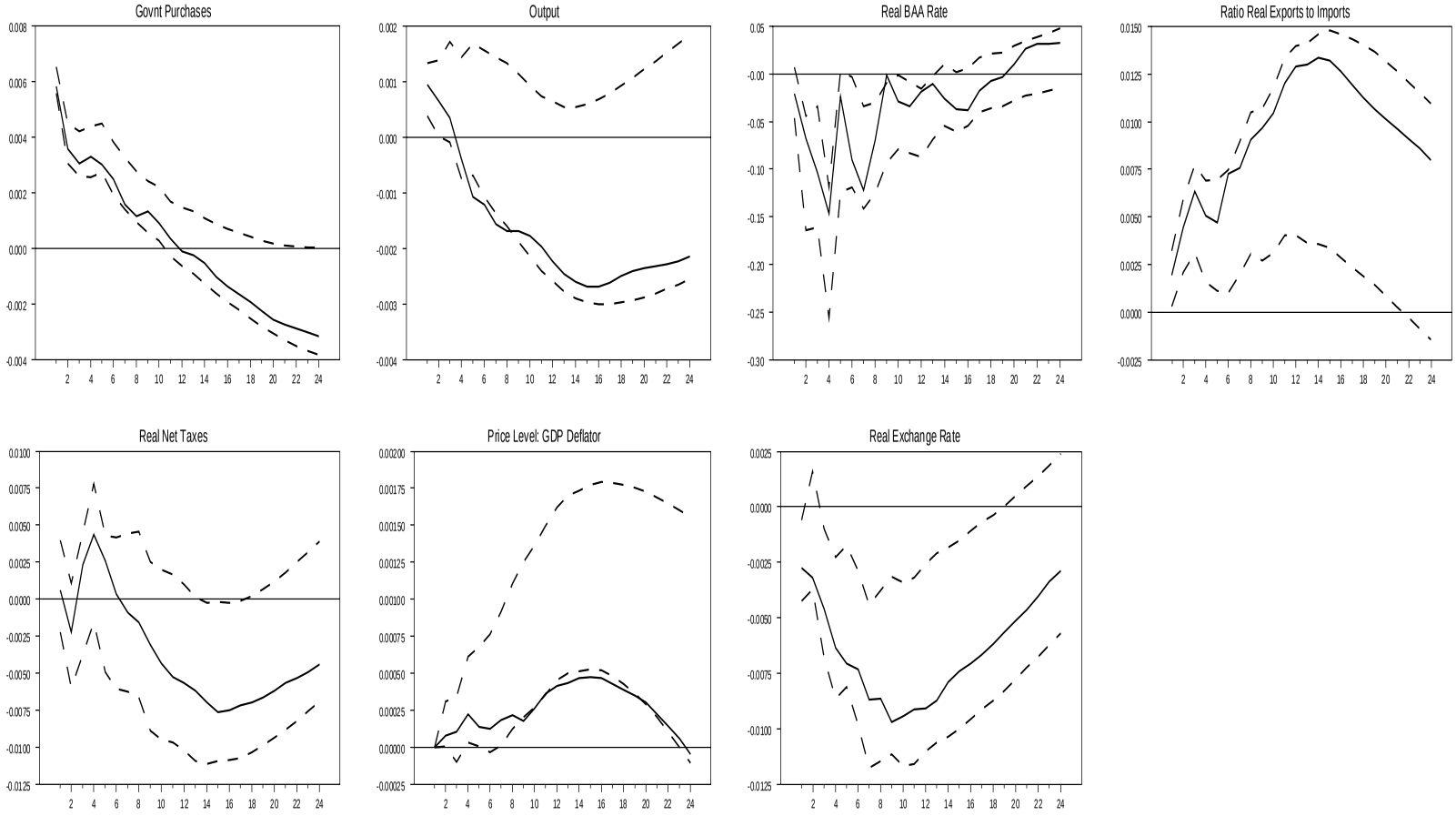
Appendix Figure 14: Negative Shock to Real Net Taxes

Model with 3 lags



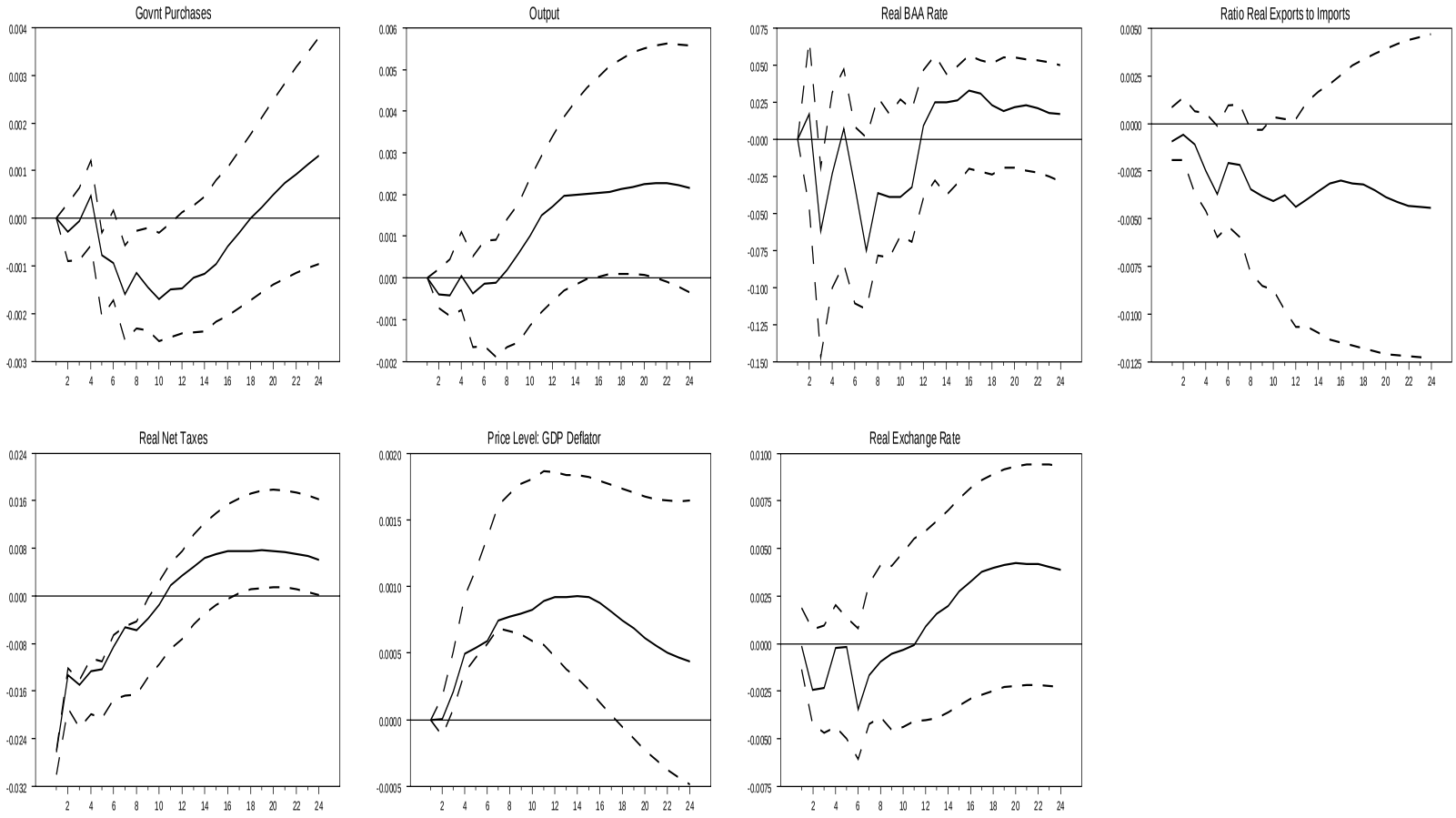
Appendix Figure 15: Positive Shock to Real Govnt Purchases

Model with 5 lags



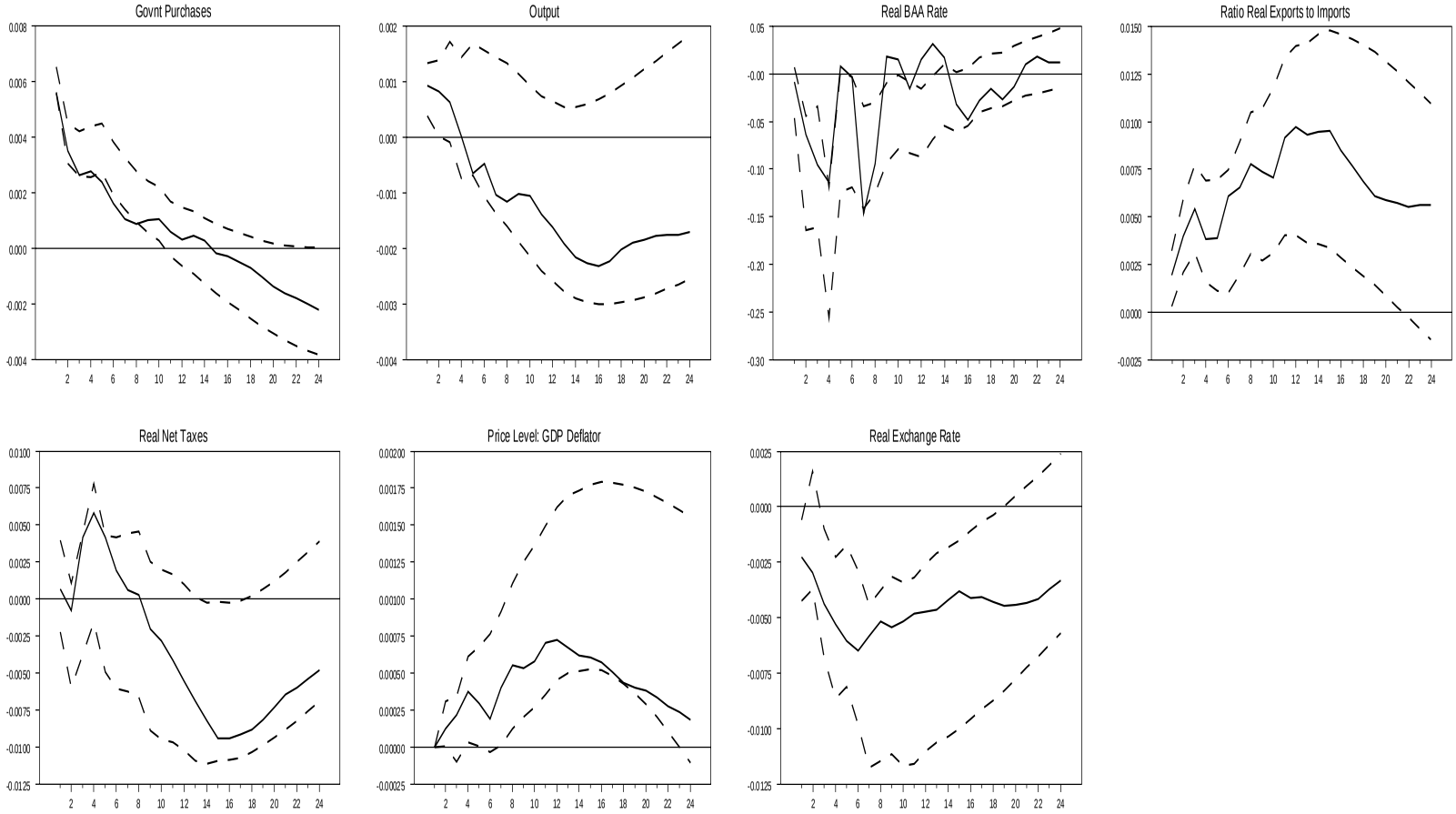
Appendix Figure 16: Negative Shock to Real Net Taxes

Model with 5 lags



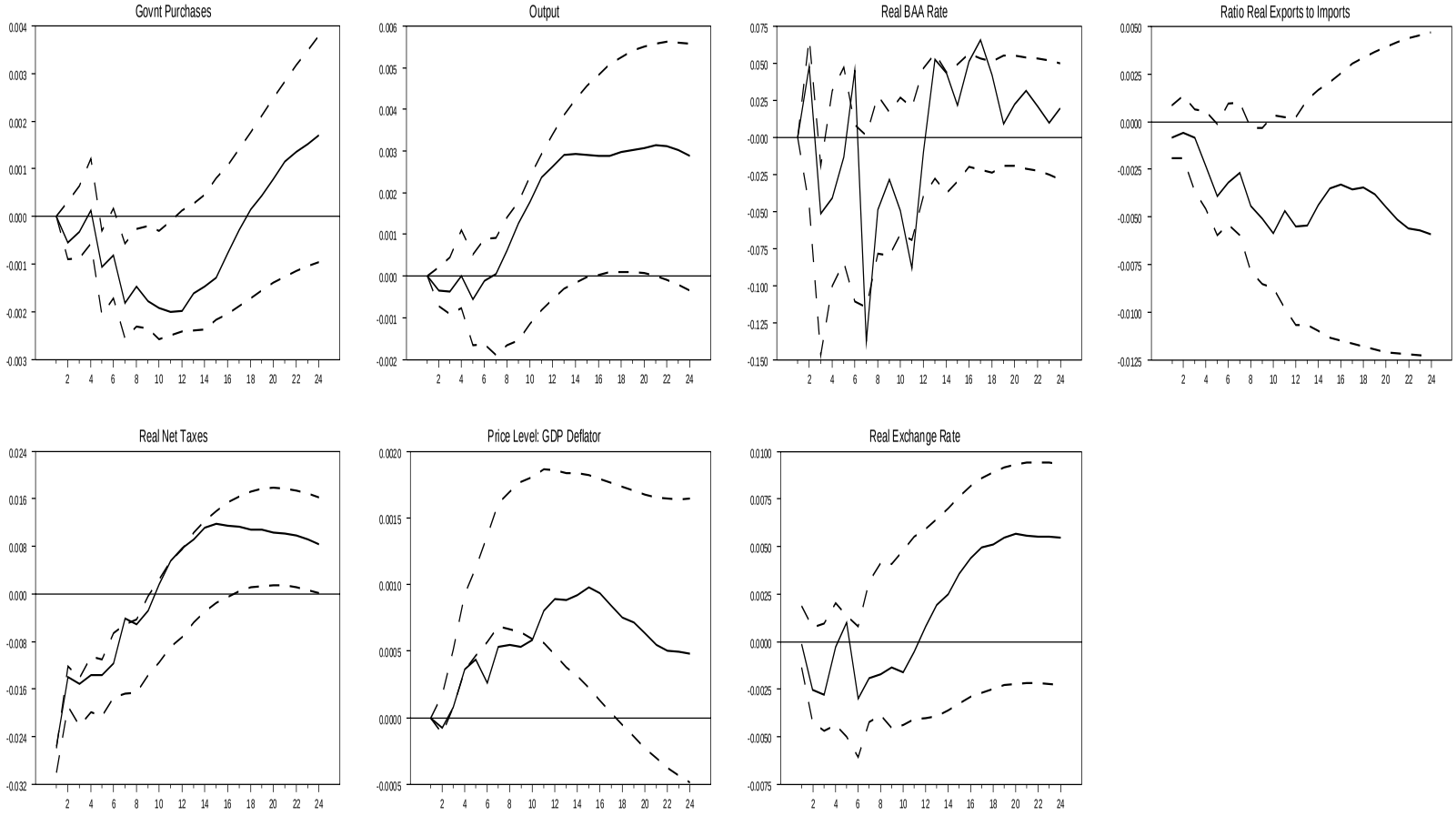
Appendix Figure 17: Positive Shock to Real Govnt Purchases

Model with 6 lags



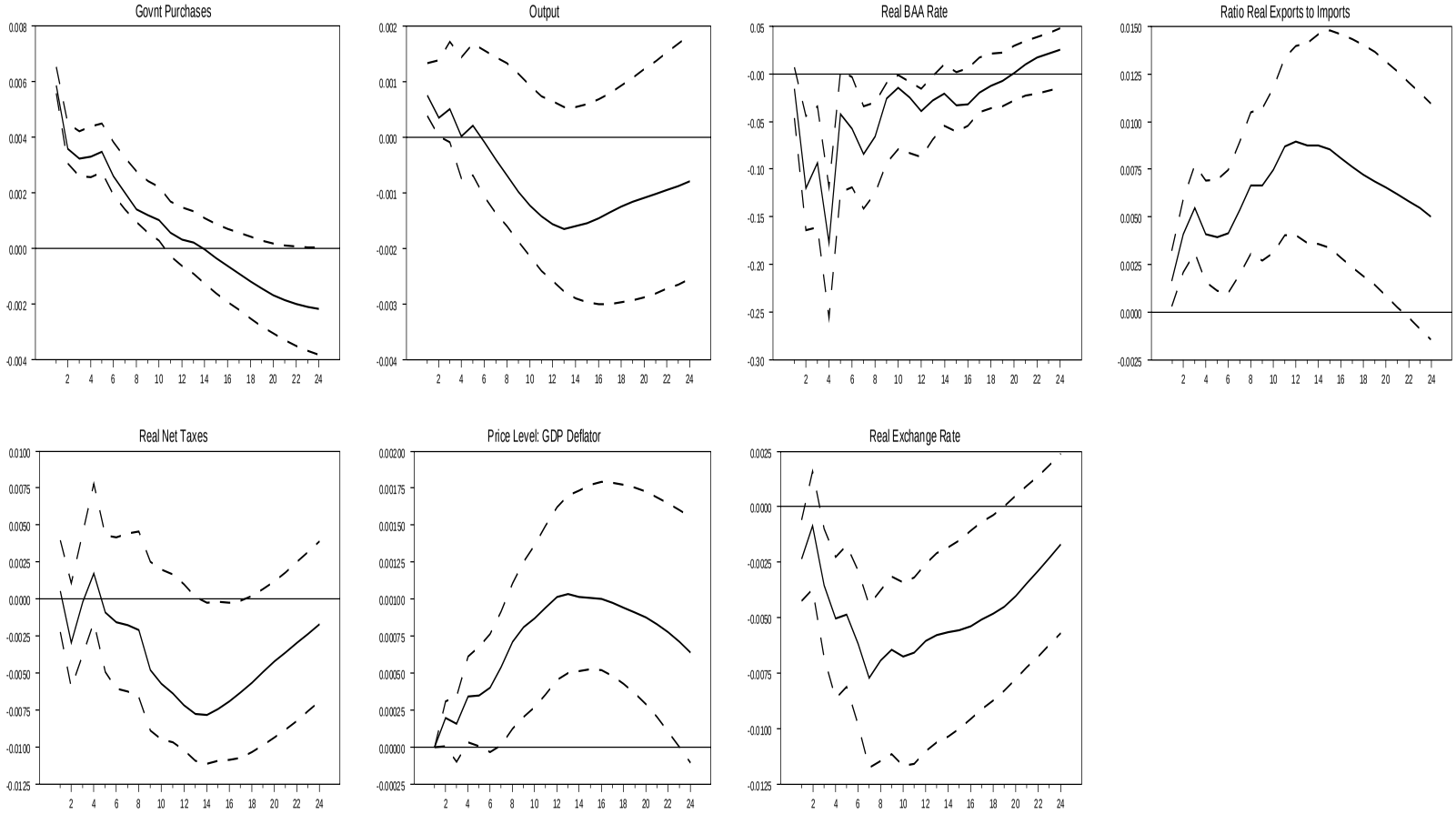
Appendix Figure 18: Negative Shock to Real Net Taxes

Model with 6 lags



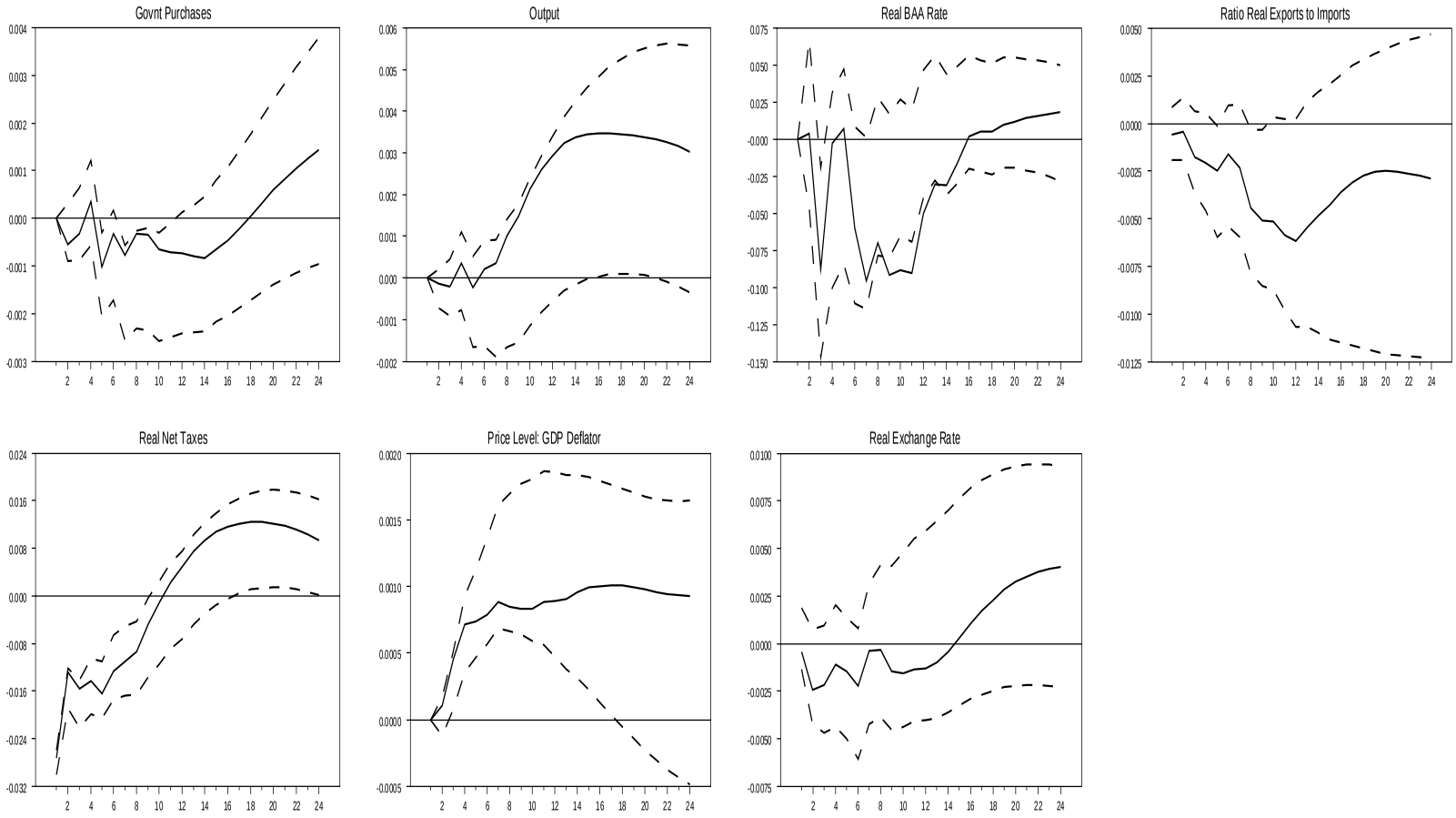
Appendix Figure 19: Positive Shock to Real Govnt Purchases

Model with Current & 4 lags of Relative Oil Prices



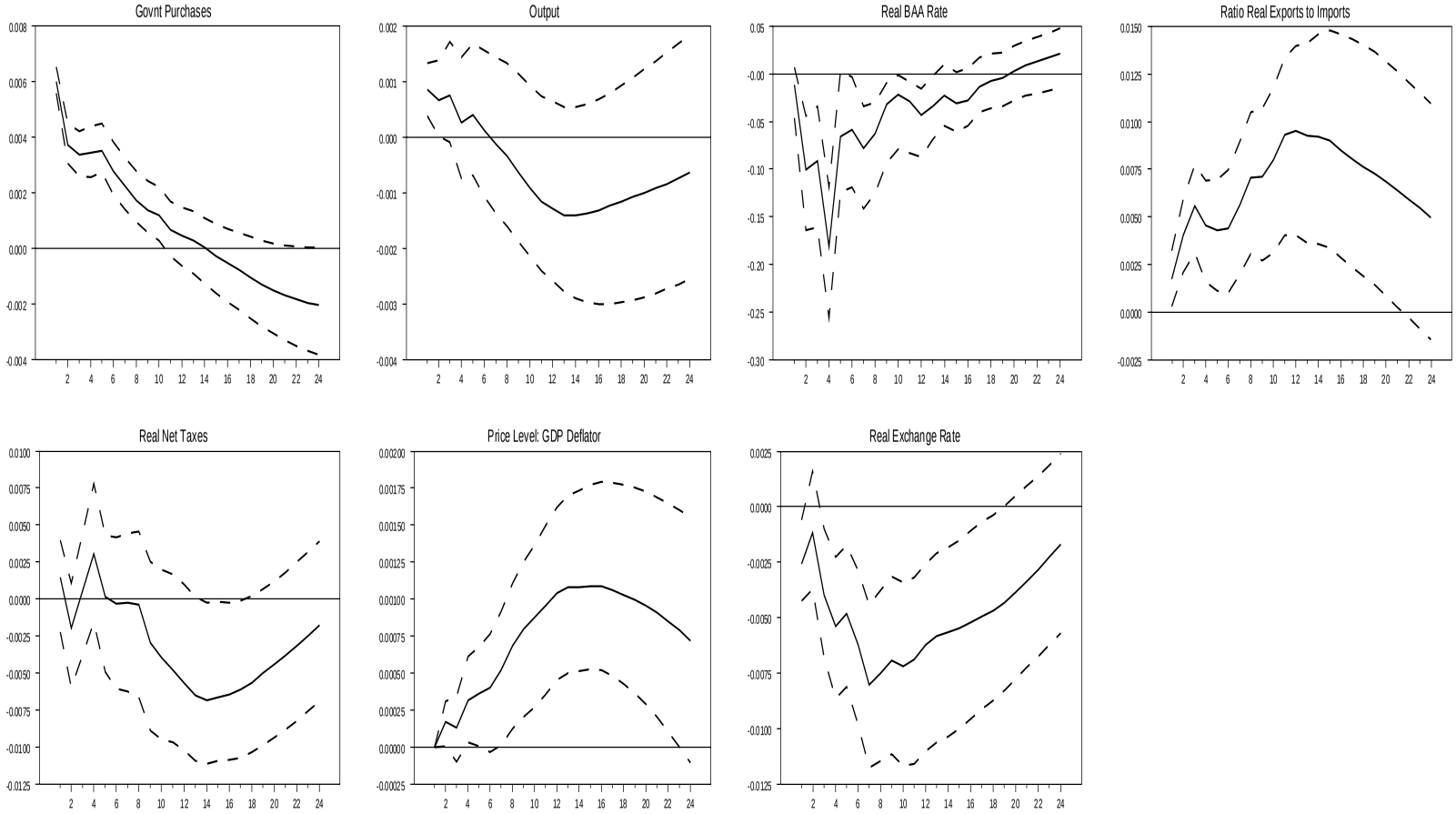
Appendix Figure 20: Negative Shock to Real Net Taxes

Model with Current & 4 lags of Relative Oil Prices



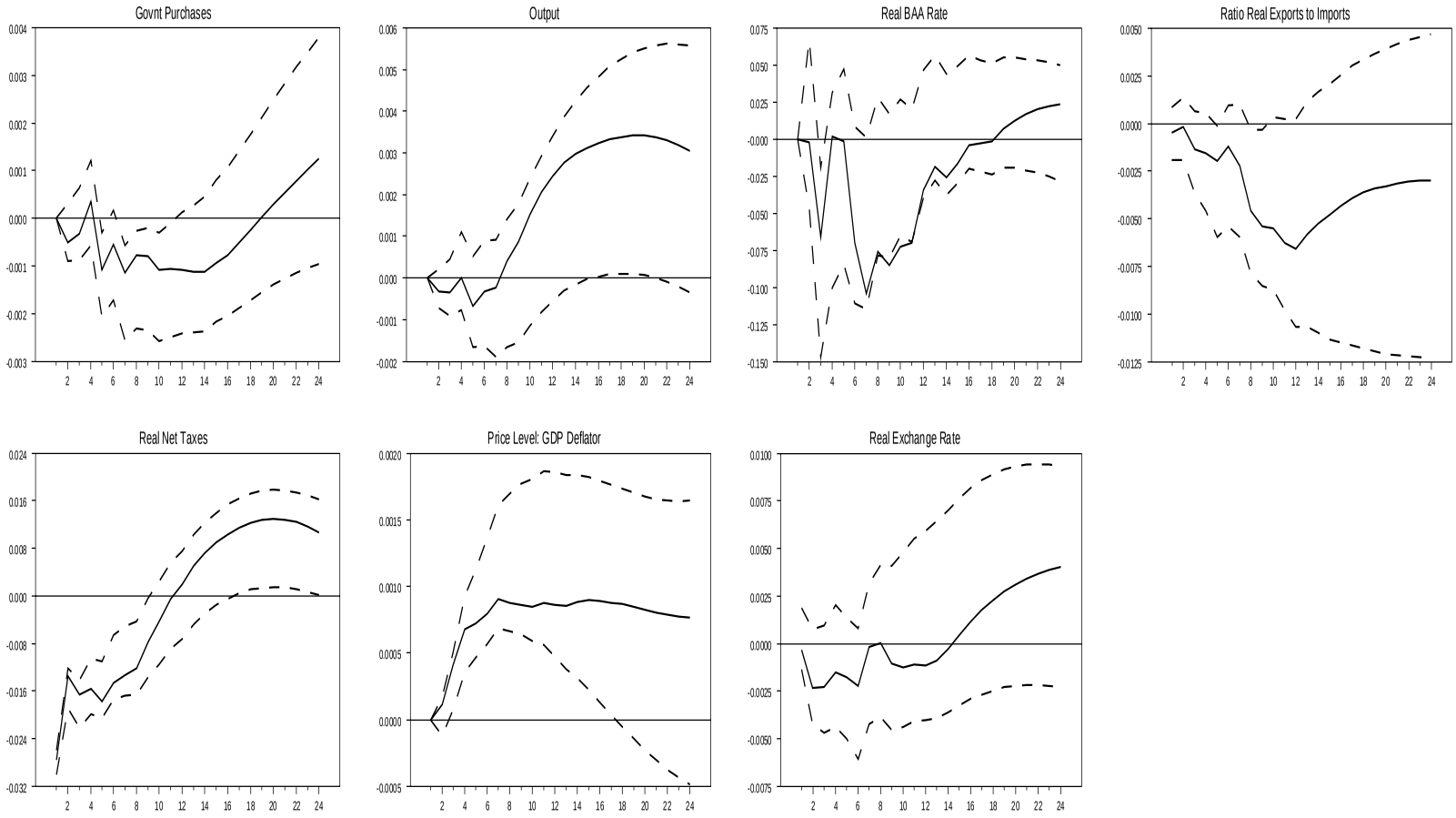
Appendix Figure 21: Positive Shock to Real Govnt Purchases

Model with Current Value Relative Oil Prices



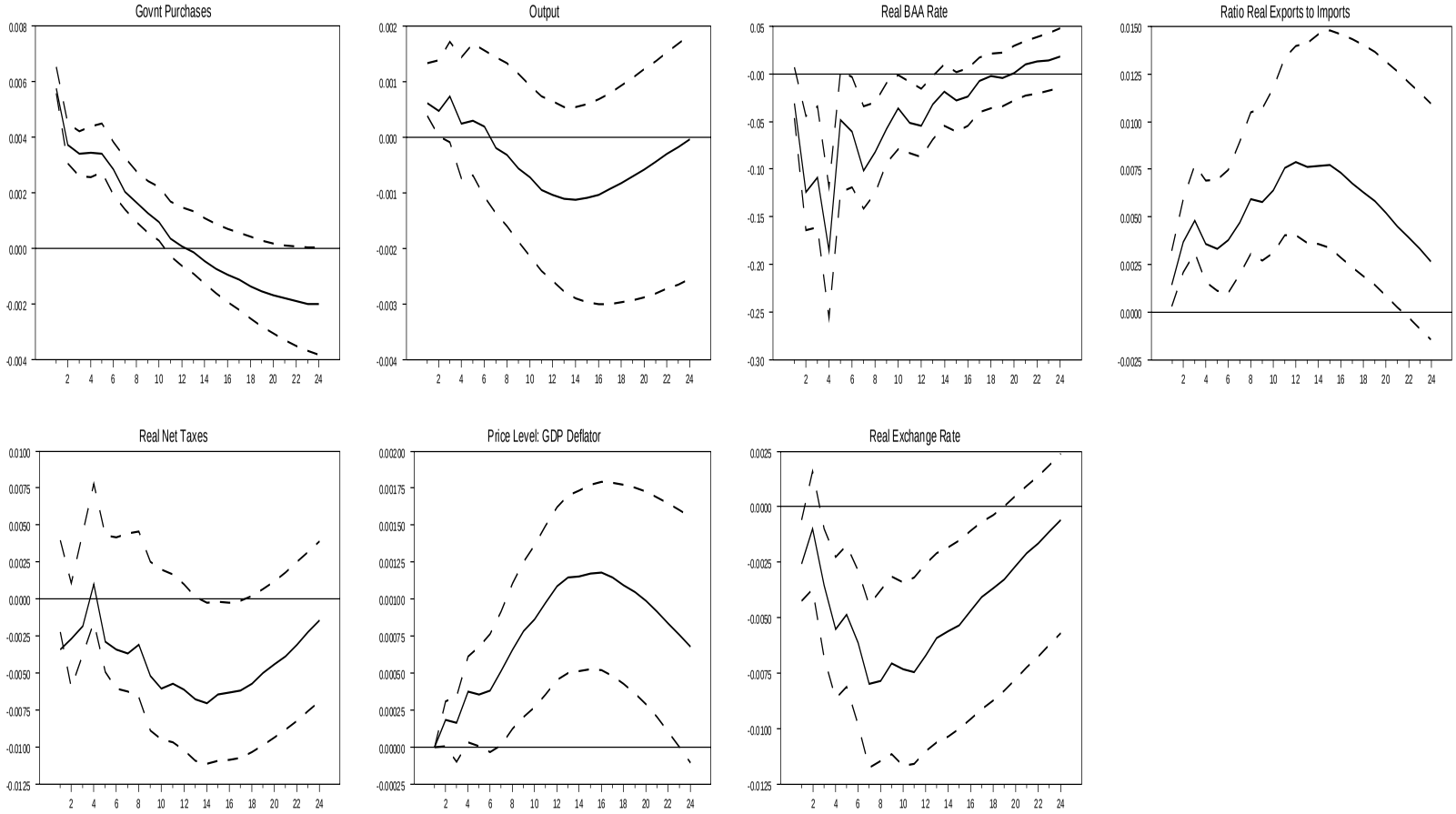
Appendix Figure 22: Negative Shock to Real Net Taxes

Model with Current Value Relative Oil Prices



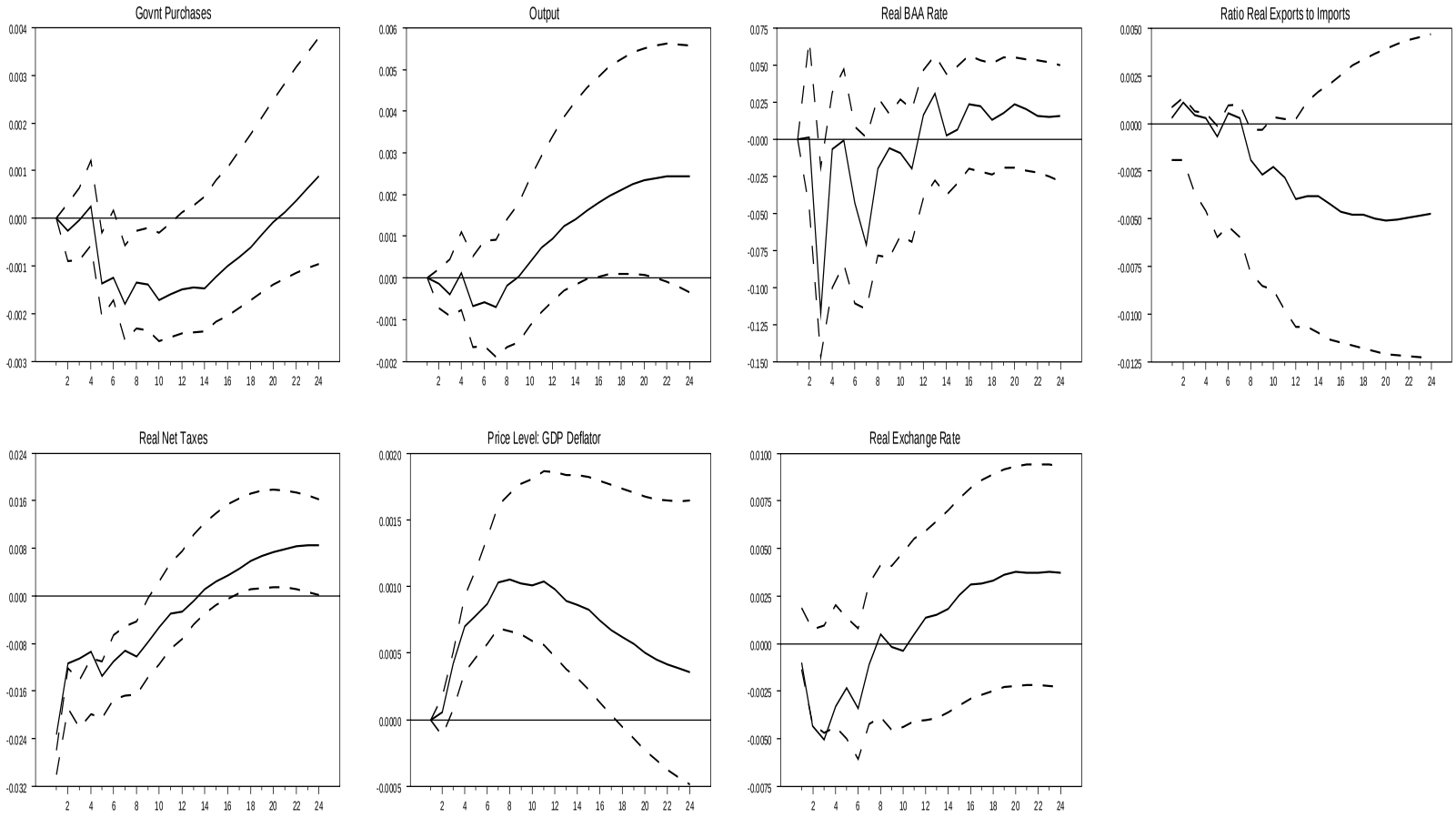
Appendix Figure 23: Positive Shock to Real Govnt Purchases

Model with Current & 4 lags of 9/11 Dummy



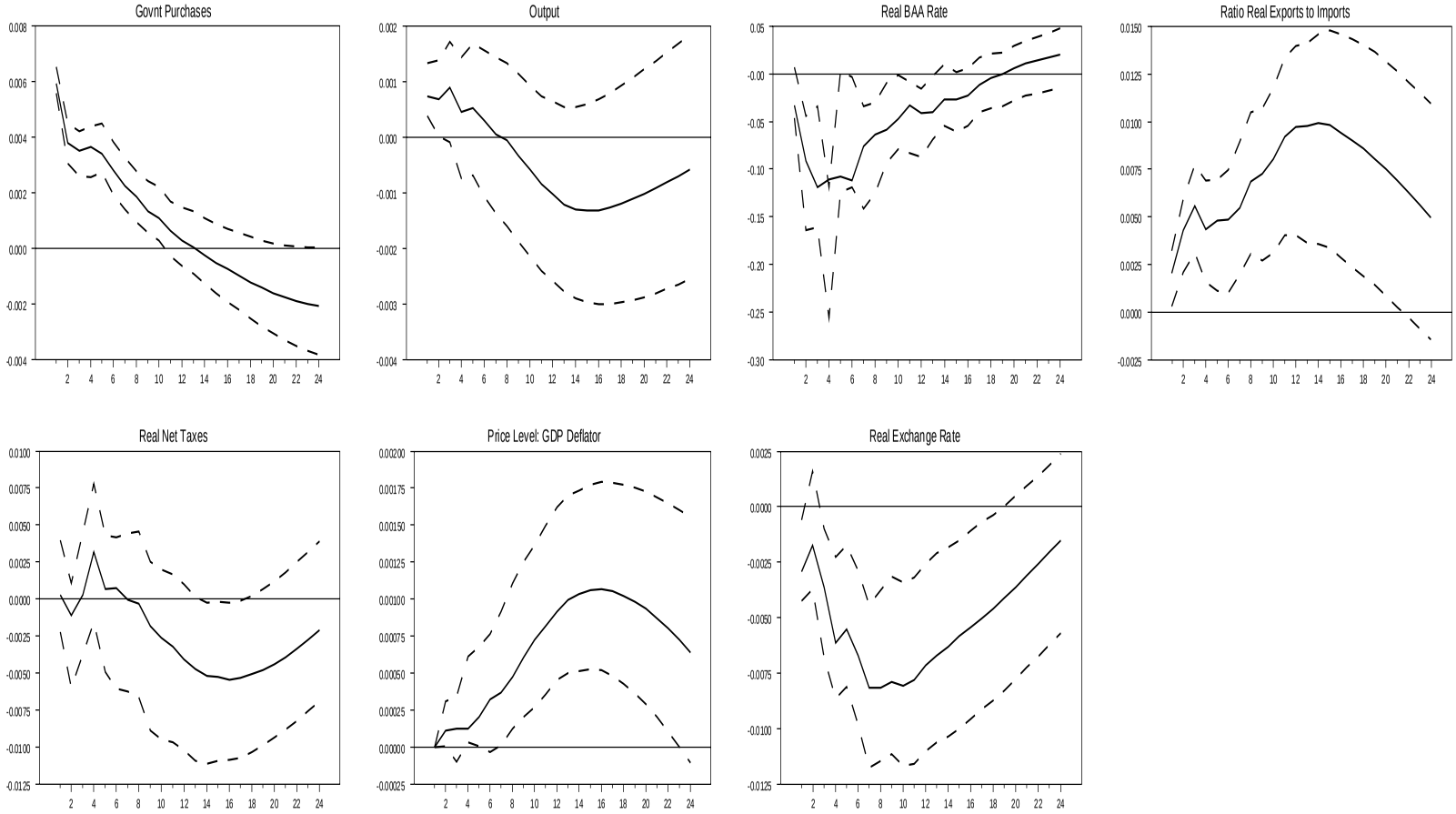
Appendix Figure 24: Negative Shock to Real Net Taxes

Model with Current & 4 lags of 9/11 Dummy



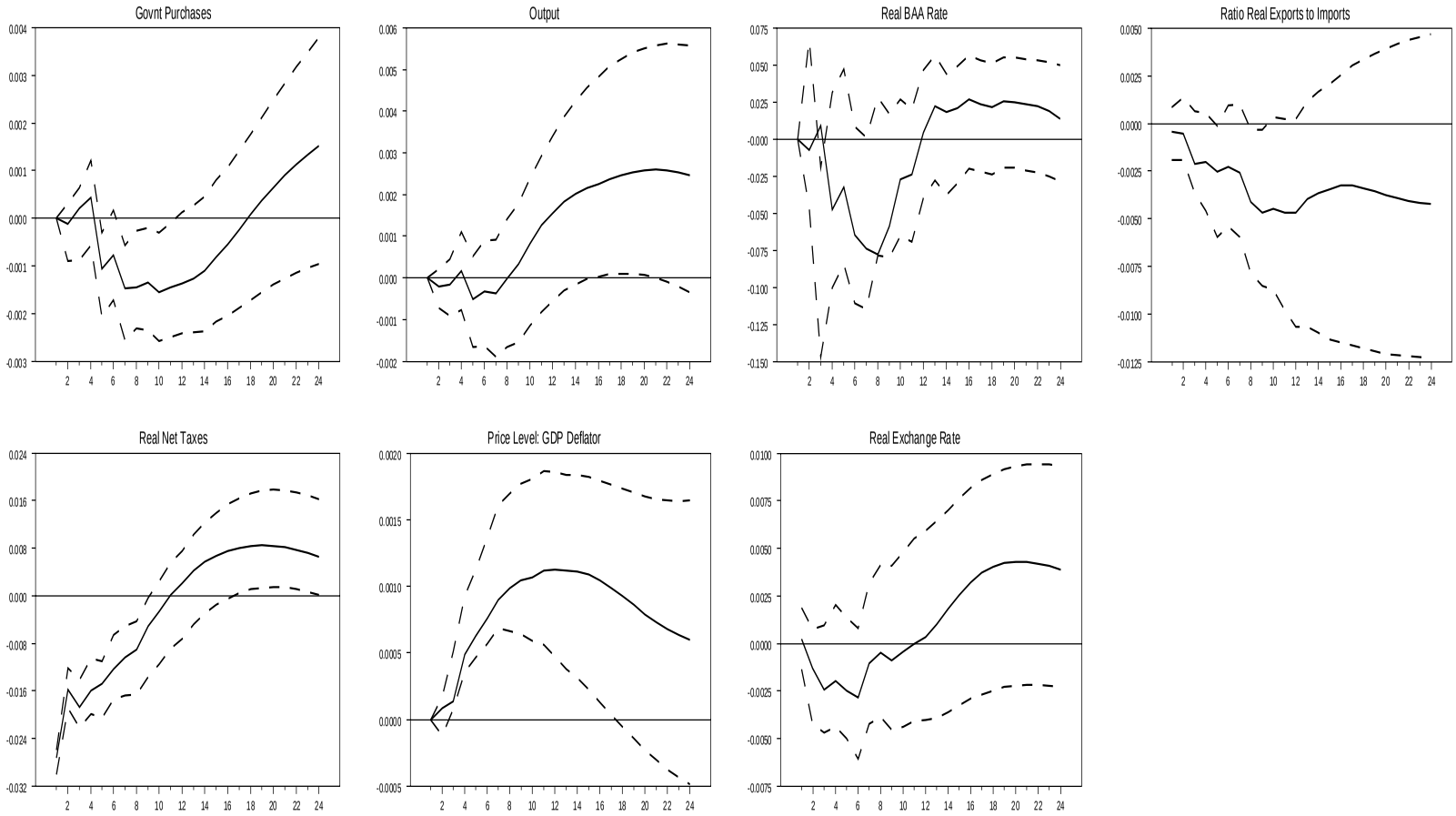
Appendix Figure 25: Positive Shock to Real Govnt Purchases

Model with seasonal dummies



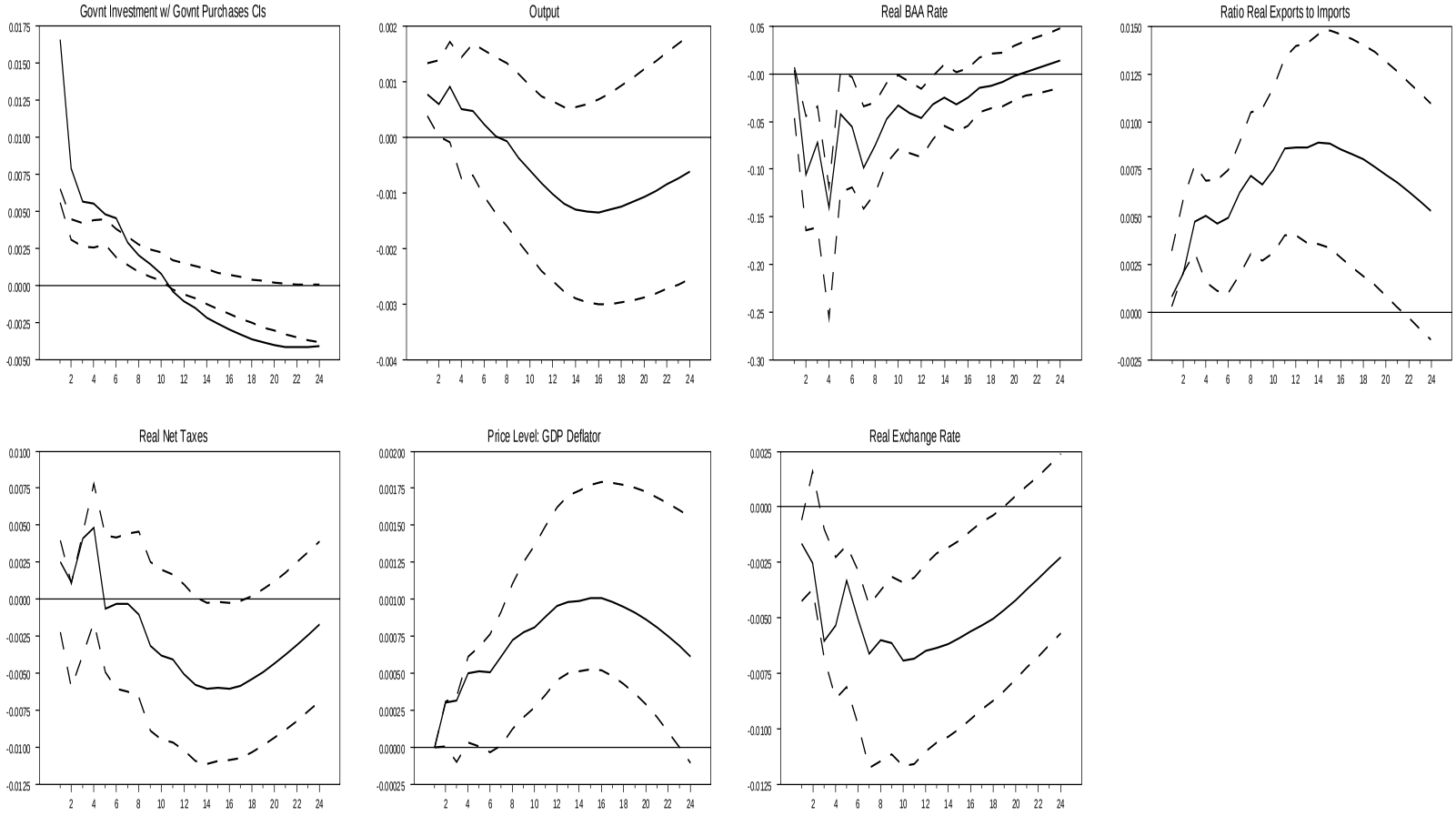
Appendix Figure 26: Negative Shock to Real Net Taxes

Model with seasonal dummies



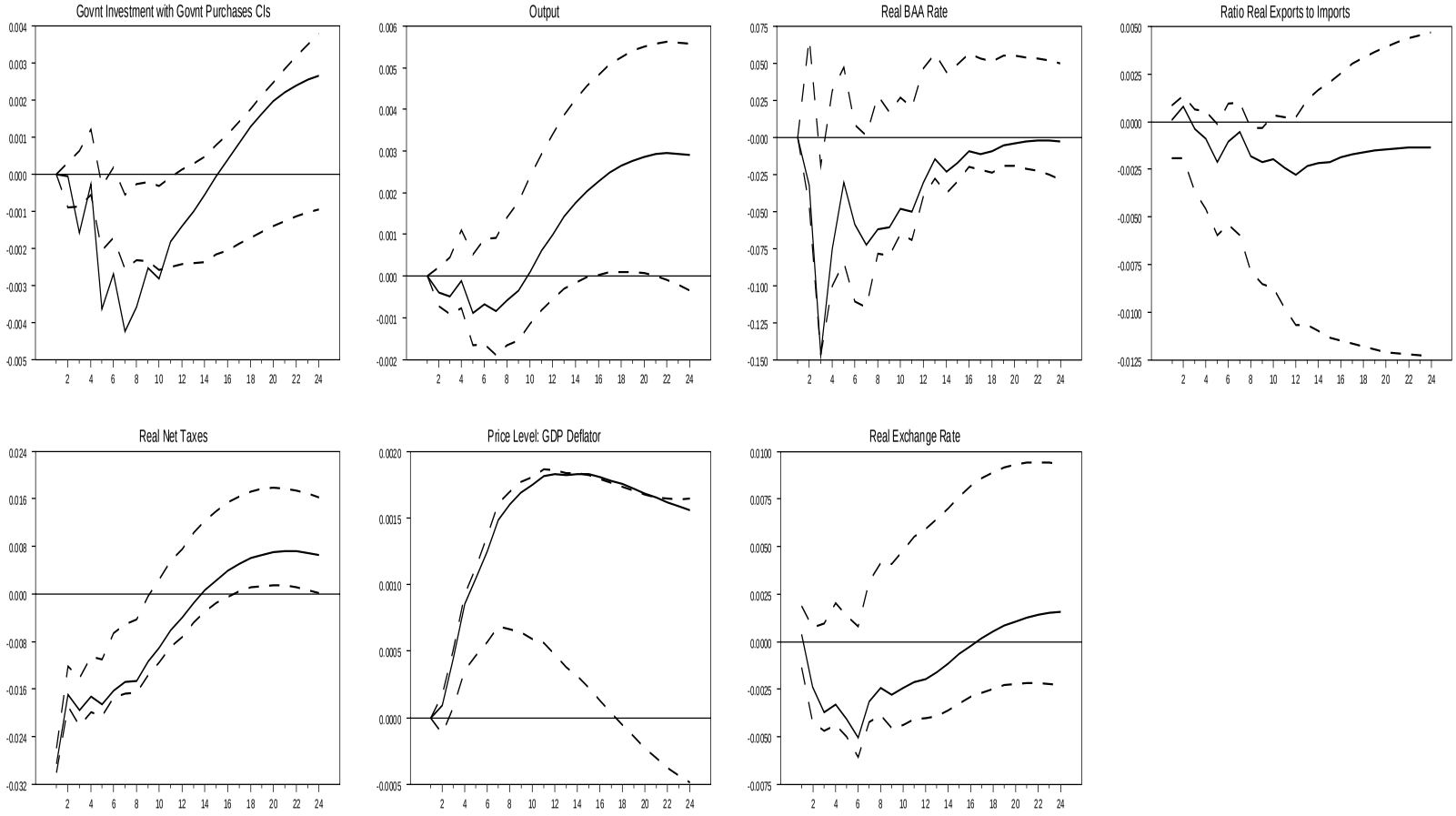
Appendix Figure 27: Positive Shock to Real Govnt Purchases

Point Estimates from Model with Government Investment



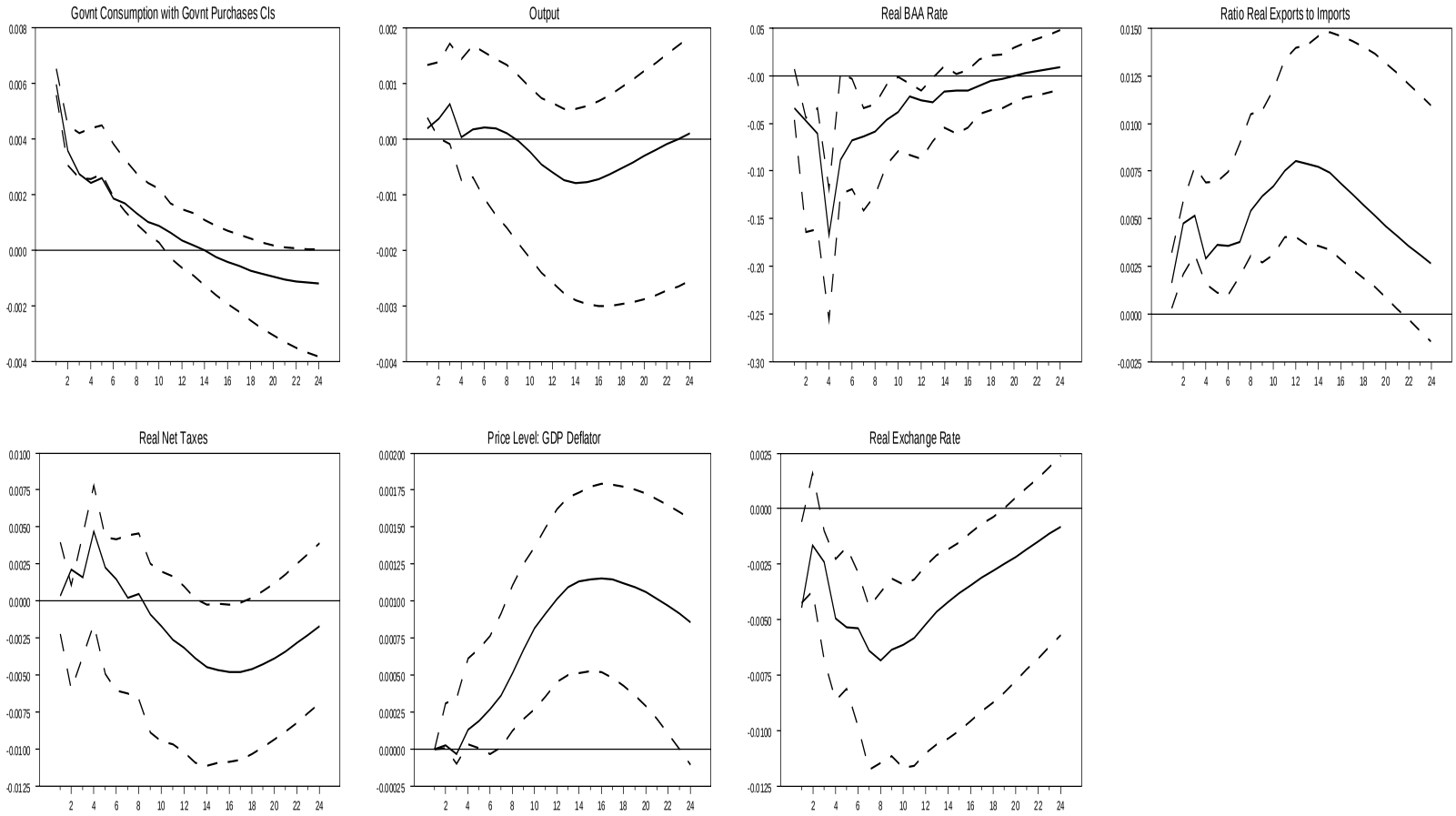
Appendix Figure 28: Negative Shock to Real Net Taxes

Point Estimates from Model w/ Government Investment



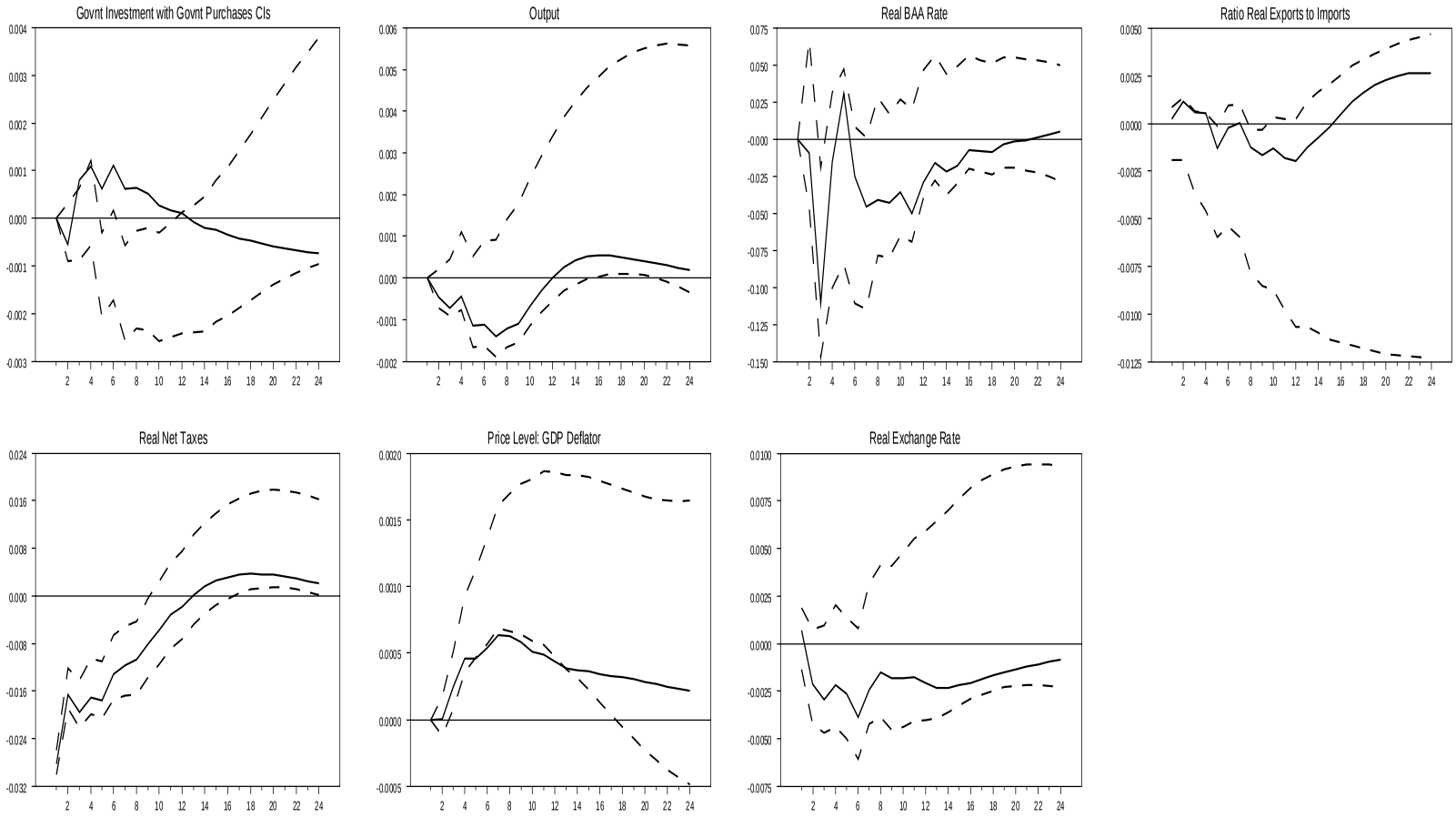
Appendix Figure 29: Positive Shock to Real Govnt Purchases

Point Estimates from Model w/ Government Consumption



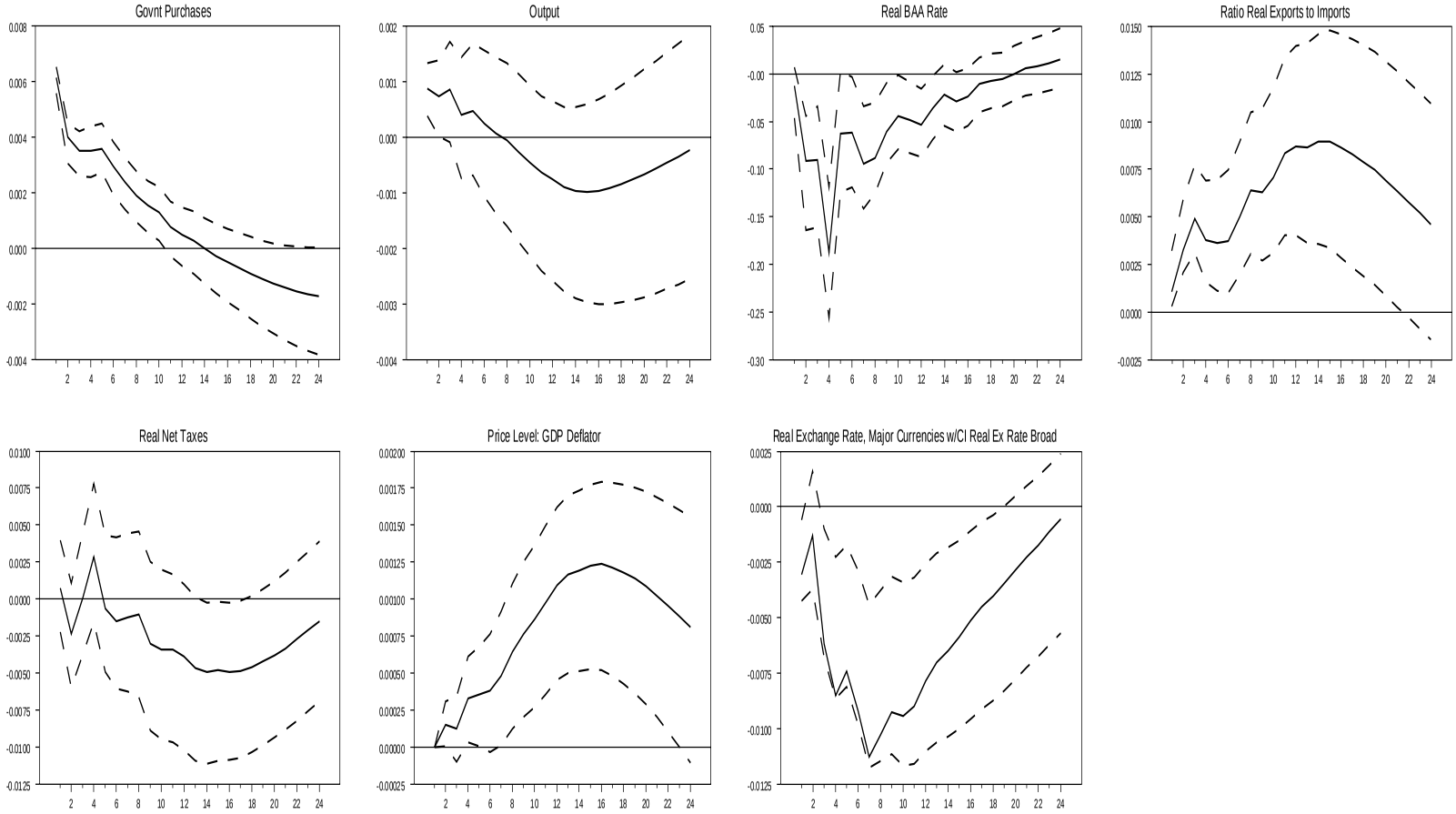
Appendix Figure 30: Negative Shock to Real Net Taxes

Point Estimates from Model w/ Government Consumption



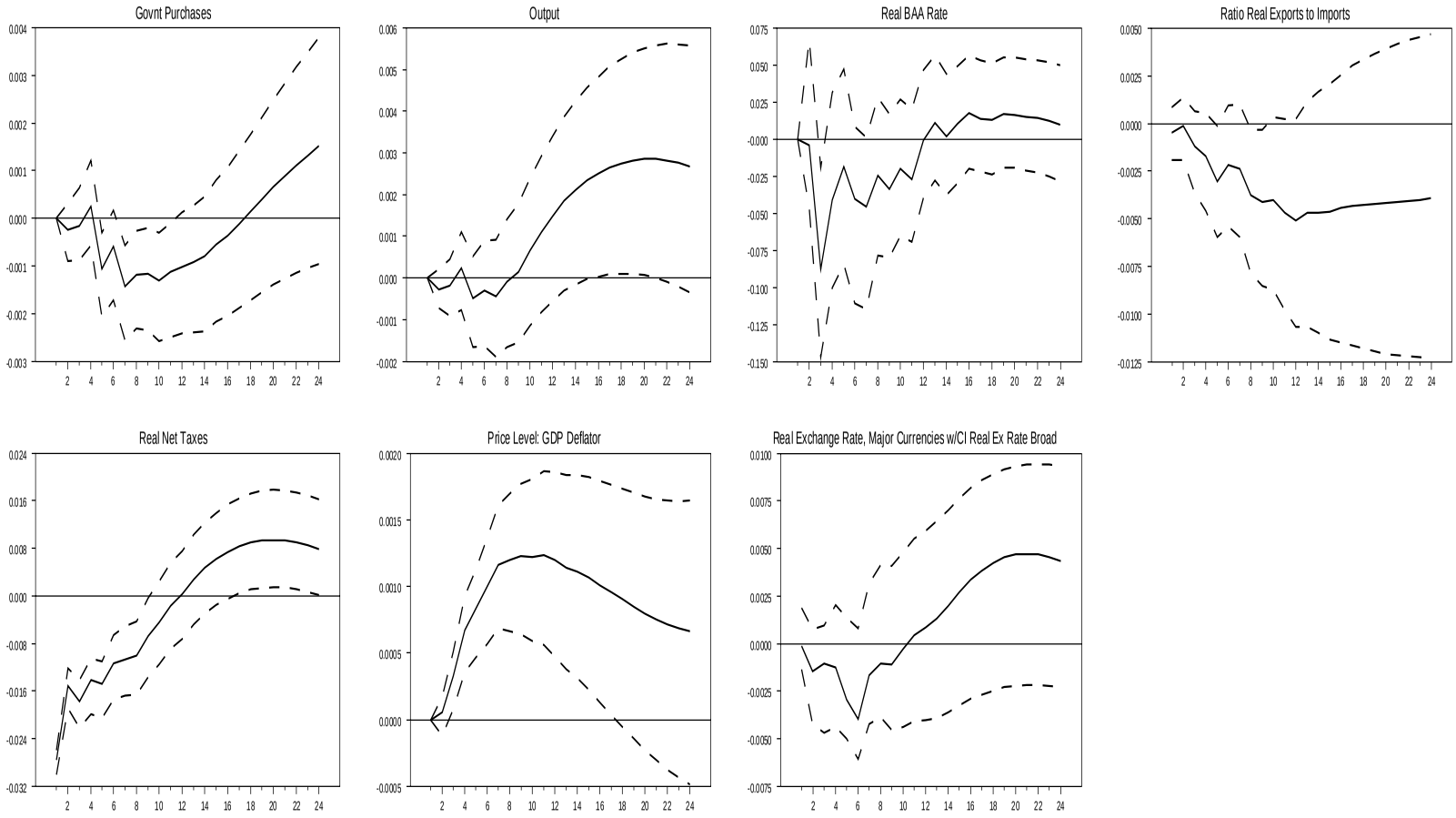
Appendix Figure 31: Positive Shock to Real Govnt Purchases

Model with Major Currencies Real Exchange Rate



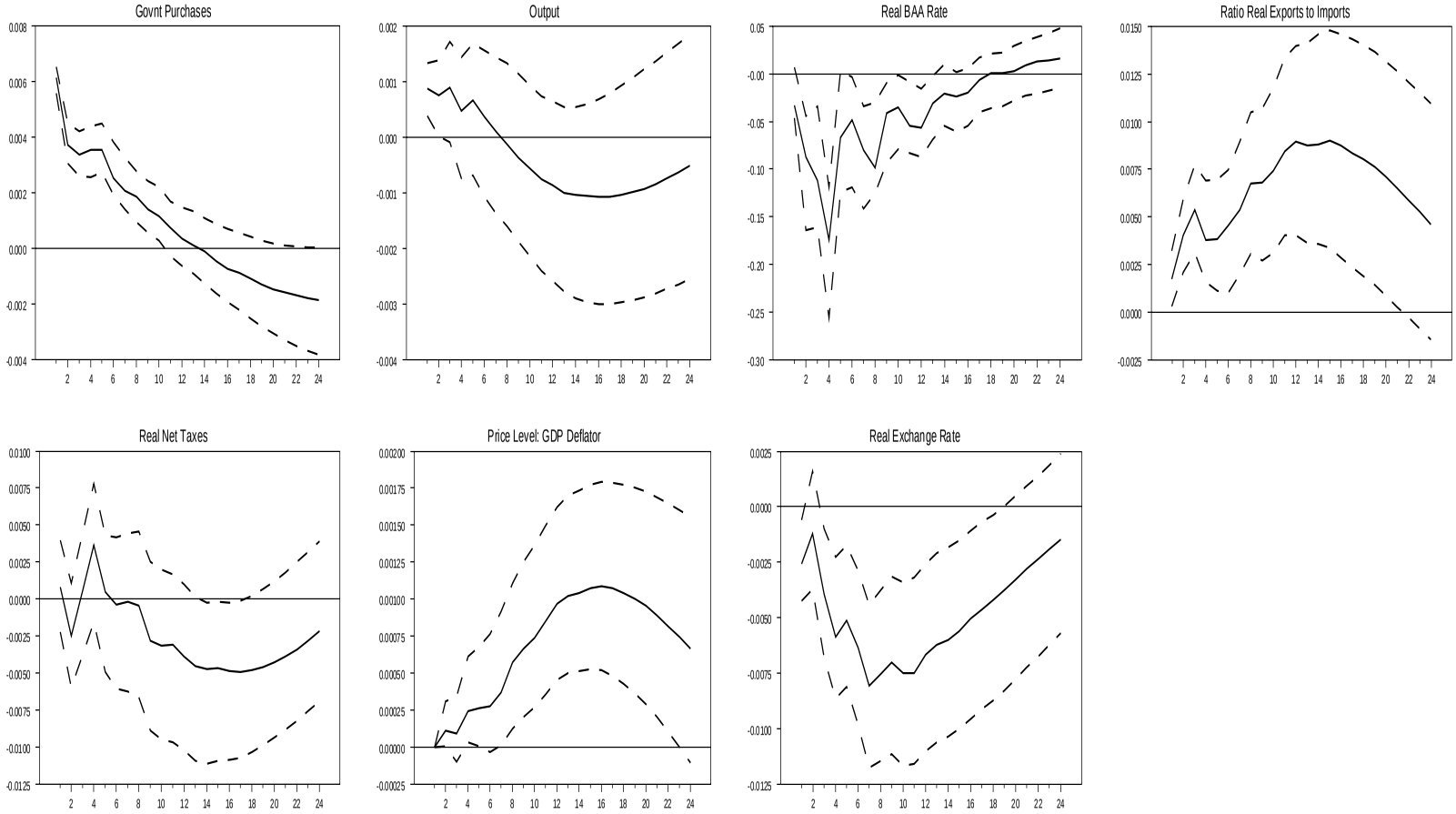
Appendix Figure 32: Negative Shock to Real Net Taxes

Model with Major Currencies Real Exchange Rate



Appendix Figure 33: Positive Shock to Real Govnt Purchases

Model w/ Ex Post Real Baa Rate



Appendix Figure 34: Negative Shock to Real Net Taxes

Model w/ Ex Post Real Baa Rate