THE INTERDEPENDENCE OF FISCAL AND MONETARY POLICY

THE INTERACTION BETWEEN MONETARY AND FISCAL POLICY THROUGH THE LENS OF A SEMI-STRUCTURAL MODEL: THE CASE FOR CENTRAL AMERICA AND THE DOMINICAN REPUBLIC

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The Interaction between Monetary and Fiscal Policy through the Lens of a Semi-Structural Model: The Case for Central America and the Dominican Republic*

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Abstract

The interaction between fiscal and monetary policy has been widely studied, primarily focusing on a framework where there is fiscal dominance and government deficits are financed by the central bank, thus imposing a constraint in the effectiveness of monetary policy. However, even without fiscal dominance, government spending could affect market interest rates even when the central bank keeps its rate unchanged, affecting the transmission mechanism of monetary policy and altering the effect of fiscal expansions on the economy. Considering this effect, we study the interaction between fiscal and monetary policies in the Dominican Republic, Costa Rica and Guatemala after their transition to inflation targeting regimes, estimating the impact of fiscal shocks on market interest rate spreads. Using a semi-structural model for policy analysis, we find evidence suggesting that the effectiveness of monetary and fiscal policy is affected by the role of fiscal policy in determining market interest rates.

JEL Codes: E42, E52, E58, E62, E63.

Keywords: Monetary policy, fiscal policy, coordination.

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1 Introduction

After the period of great inflation in the 70's and 80's, policymakers in developing economies understood that breaking the direct link between central banks and fiscal policy was a key element to build up credibility of monetary policy. Back then, large fiscal deficits were financed with central bank (CB) money through credit lines from the CB to the ministry of finance, reflecting the lack of independence and strengthening fiscal dominance. As a response, central banks and monetary authorities were provided with legislation guaranteeing the partial or complete independence of monetary policy control over its instruments, and preventing deficit financing policies. This translated into some level of independence between monetary and fiscal policy.

Despite autonomy of central banks, there is room for the effects of these policies to interact with one another potentially enhancing or demeaning their impacts: (1) in countries where commercial bank credit is an important source of private agents financing, fiscal shocks destabilize credit markets (crowding out), rising interest rate spread and triggering monetary policy response; and (2) countries where government finance their deficits selling bonds in domestic financial markets and through commercial bank credit, fiscal policy under debt rules interact with monetary policy in the short run.

In this paper, we study the link between fiscal and monetary policies in the Dominican Republic, Costa Rica and Guatemala. These countries have been reforming their monetary policy frameworks during the last decade, from fixed exchange rate and monetary targeting regimes to inflation targeting, where the interest rate is the main policy instrument and its stabilization is a major issue in evaluating the effectiveness of monetary policy rates as signal device of the policy stance.

We explore the importance and implication for monetary policy of the interest rate channel of fiscal shocks. VAR evidence for the mentioned economies highlights the sensitivity of interest rate spread to government spending shocks, suggesting that fiscal policy decisions could have an impact in the monetary policy transmission mechanism by affecting the relevant interest rate for agents' consumption and investment decisions. We then formalize the mechanism of this empirical feature specifying a semi-structural model where the spread between monetary policy rate and market interest rate is a function of fiscal variables, and estimate the spread sensitivity to changes in fiscal policy behavior. We find that the response of the inflation and the output gap to these fiscal shocks is affected by the interaction between fiscal variables and monetary policy reaction through the interest rate channel.

The rest of the document is organized as follows. Section 2 reviews the relevant literature on this topic, Section 3 presents some empirical evidence and then describes the model, and Section 4 explains the estimation procedure as well as the data used. Afterwards, Section 5 presents the estimation results and some simulated responses with

our model. Finally, Section 6 concludes.

2 Literature Review

The theoretical relationship between inflation and fiscal deficits has been studied in detail. For instance, Sargent & Wallace (1981) argue that in an economy where there is fiscal dominance and the government chooses a trajectory of fiscal deficits that must be financed by bond sales and seigniorage, the central bank's ability to control inflation is constrained by the demand for government bonds. This view of fiscal pushed inflation has been widely used in the literature in developing countries, where in addition to a more restrained government bond demand, political instability increases the dependence on inflation tax (Cukierman et al. 1992).

This view is empirical corroborated by Catao & Terrones (2005), who model inflation as non-linearly related to fiscal deficits and estimate this relationship dynamically for a panel of countries, finding a strong positive relation between fiscal deficits and inflation in high-inflation environments and developing countries.

Another scenario in which the interaction between monetary and fiscal policy takes relevance is when evaluating the ability of government spending to influence output. For instance, some sticky price models establish an "expected inflation" channel through which government spending drives up inflation expectations, thus reducing real interest rates and leading to an increase in private consumption. This response of output to changes in government spending appears to be larger under a passive monetary policy, in contrast to an active monetary policy (Dupor & Li 2015). In a similar fashion, Canova et al. (2011) find that the way in which monetary policy reacts to fiscal expansions is crucial in determining the magnitude of per-capita output multipliers.

Additionally, the possible effect of fiscal policy on the interest rate is another channel through which monetary and fiscal decisions interact. Most modern central banks use a reference interest rate as their policy instrument. In many developed economies, the CB uses open market operations to influence money supply and market interest rates. In other CBs, such as the ones from Central America and the Caribbean included here, the monetary authority influences the market interest rates by setting directly the rate at which the commercial banks can borrow and deposit money excess in the CB. In any case, the objective is to use the monetary policy rate as a signal for the rest of the market interest rates. However, there is evidence that the government's fiscal policy plays a role in determining market rates and could influence the term structure of interest rates.

In this line, Dai & Philippon (2005) find that lasting government deficits affect long-term interest rates due to a combination of higher expected spot rates and higher risk premium. However, there is evidence that bond yields tend to react to news of projected future government spending instead of contemporaneous spending (Kučera et al. 2019).

Another way of thinking about this, is to introduce a spread, which reacts to fiscal shocks, between the monetary policy rate and the market relevant interest rate. Following this idea, Bredemeier et al. (2015) introduce such a spread in an otherwise standard macro model and find that expansionary fiscal policy increases this interest rate spread, hence rising market interest rate even when the monetary policy rate is unchanged.

Nonetheless, the evidence of the effect of fiscal policy on interest rate is not clear and, in fact, the estimation of the impact of government debt financing on interest rate appears to be dependent on the specification and the definition of variables (Engen & Hubbard 2004) .

3 Empirical Strategy

To study the relationship between fiscal and monetary policy, a semi structural macroeconomic model for a small open economy is estimated. We propose a model traditionally used for policy analysis (e.g, Berg et al. 2006) where the equations are log-linearized representations of the steady state solution of the structural model.

In particular, the model's main equations include a Phillips Curve, an aggregate demand equation, a Taylor rule for the policy rate determination, an UIP condition, and the debt accumulation dynamics. In the model, fiscal and monetary policy interact in several ways, but we are mostly interested in their relationship through the interest rate spread between the monetary policy rate and the market interest rate, so we include an interest rate determination block were we model explicitly this spread, following Bredemeier et al. (2015).

In order to justify the pertinence of including this interest rate spread in the model and the effects of the fiscal policy on it, some empirical evidence is analyzed. In first place, we calculate this spread for two economies from Central America (Costa Rica and Guatemala) and the Dominican Republic and describe its evolution over time. Afterwards, we introduce the interest rate spread in a fiscal VAR to evaluate if a fiscal shock has some empirical effect on the spread.

3.1 Empirical Evidence

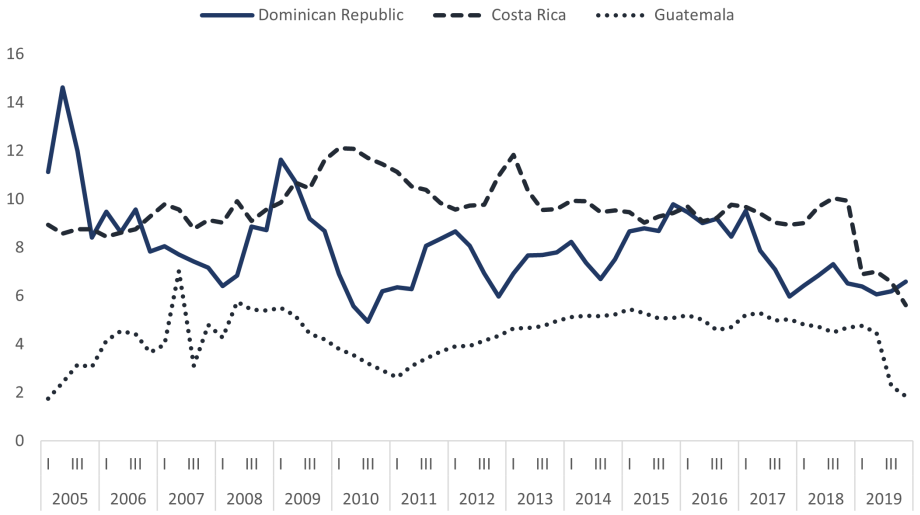
In the traditional policy analysis model, the relevant interest rate is the one associated with the monetary policy rate of the Central Bank. To conduct its monetary policy, the Central Bank moves this interest rate to influence the rest of the market rates.

However, the interest rate that consumers and investors face in the market, hence the relevant rate for their decision making, is different from the monetary policy rate. To introduce this notion into a semi-structural model as presented in here, one can argue that the market interest rate moves with the monetary policy rate, but there is a

spread between them. If this spread reacts to fiscal policy shocks, then the transmission mechanism of the monetary policy is going to be affected.

To assess this, we calculate the spread between the short-term interest rate on loans from commercial banks and the inter-bank interest rate, as a proxy of the monetary policy rate. The results are presented in Figure (1) for Costa Rica, Dominican Republic and Guatemala. As can be seen, the spread is not fixed in neither of these countries, although it follows different patterns. These differences are expected since interest rate spreads depend on several micro and macro variables that are specific for each economy (Jorgensen & Apostolou 2013, Amato & Luisi 2006, Were & Wambua 2014). Nonetheless, it is noticeable the impact of the financial crisis during the 2007-2009 period, causing the spreads to increase in all three countries.

Figure 1: Interest rate spread between commercial banks' short term interest for loans and the inter-bank rate (%)



Notes: The spread is defined as the difference between commercial banks short-term loan rate and the inter-bank rate. Source: Central banks and bank regulators from Costa Rica, Dominican Republic and Guatemala.

As stated before, these movements in the interest rate spread depend on several variables, including a possible effect from fiscal indicators. This is of special interest given that if government's decisions on its spending affects the spread, and hence the market interest rate, then fiscal policy is going to affect the transmission mechanism of monetary policy. To study the possible effect of fiscal shocks in the dynamics of this spread, we estimate a fiscal VAR for these economies and, following Bredemeier et al. (2015), expand it to account for the effect of fiscal shocks on the interest rate spread.

In particular, the VAR includes the logarithms of government spending, absorption (consumption and investment), GDP, all in real terms, and the interest rate spread. We also include a linear-quadratic trend. For the estimation, we use quarterly data from 2006 for Dominican Republic, 2001 for Costa Rica and 2009 for Guatemala, due to

data availability, running trough 2019QIV. The models include six, two and three lags for Dominican Republic, Costa Rica and Guatemala, respectively. In all cases, the lag structure is selected following LM residual tests.

The identification of the government spending shock is done recursively. The main idea is that, given the institutional setting of fiscal policy, the use of quarterly data eliminates the possibility that economic activity affects the discretionary adjustments to government spending in response to unexpected events within the quarter (Blanchard & Perotti 2002). In other words, given that it takes policymakers more than a quarter to learn about a GDP shock and then decide on what fiscal measures to take and actually implement them, there is a good argument to think that fiscal shocks are not related to economic conditions within the quarter. For the case of the economies studied in here, as presented by Ovalle et al. (2019), fiscal spending is also acyclic in respect to economic activity.

Figure (2) shows the impulse response function from these VAR estimations with government spending ordered first. The red dotted lines show 75% bootstrapped confidence intervals.

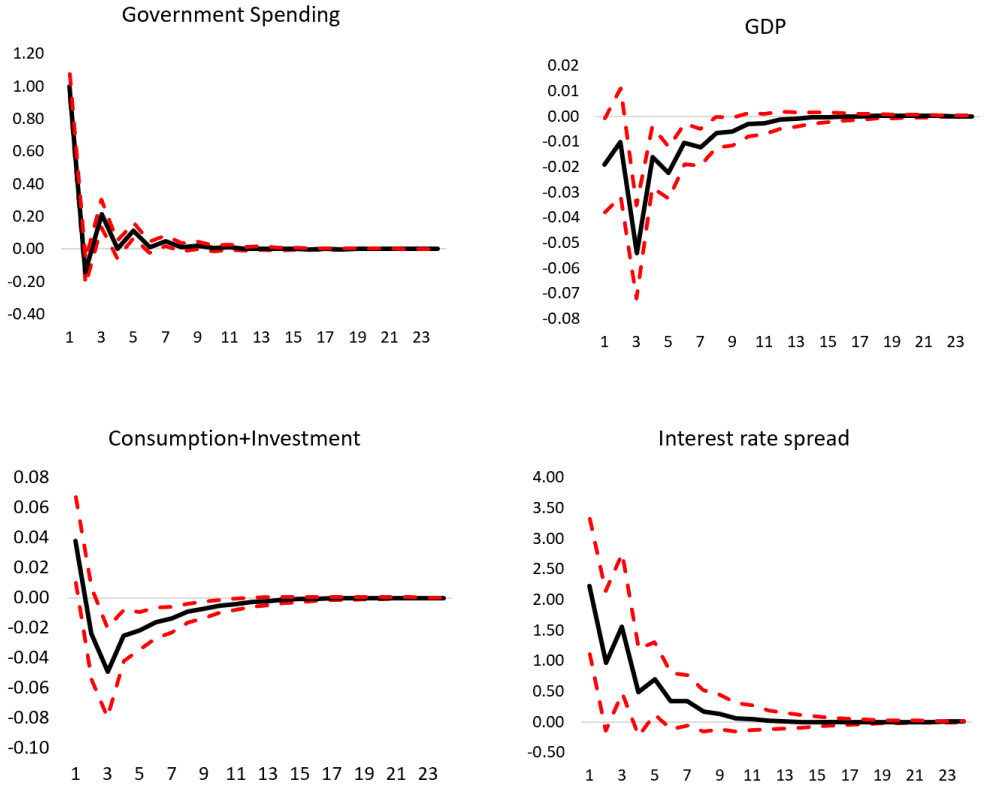
The responses differ among these economies, but some similarities can be highlighted. In all cases, there appears to be a crowding out effect of the public spending on GDP and absorption, at least in the short-term.

As can be seen, in all cases there is a positive and significant response from the interest rate spread to the fiscal shock. In Costa Rica and Guatemala, the reaction is contemporaneous, but in the Dominican Republic the spread reacts four quarters after the fiscal shock. These results are in line with the findings of Bredemeier et al. (2015) that the interest rate spread reacts to government spending in the United States.

These results highlight the importance of introducing this relationship between fiscal policy and interest rate in our model framework due to its possible impacts on the monetary policy transmission mechanism. In this setting, an expansionary fiscal policy could weaken the effects of a monetary expansion. In order to access this question, we propose a semi-structural model that accounts for this interest rate setting and helps disentangle the different mechanisms through which fiscal and monetary policy interact.

Figure 2: Responses to a government spending shock

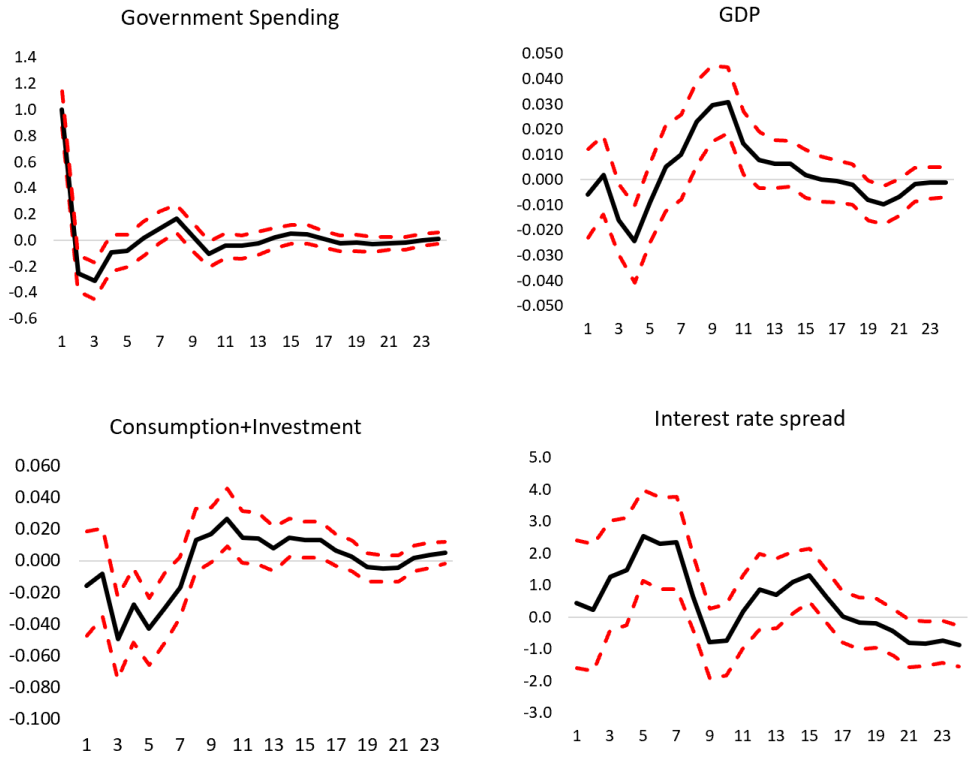
(a) Costa Rica



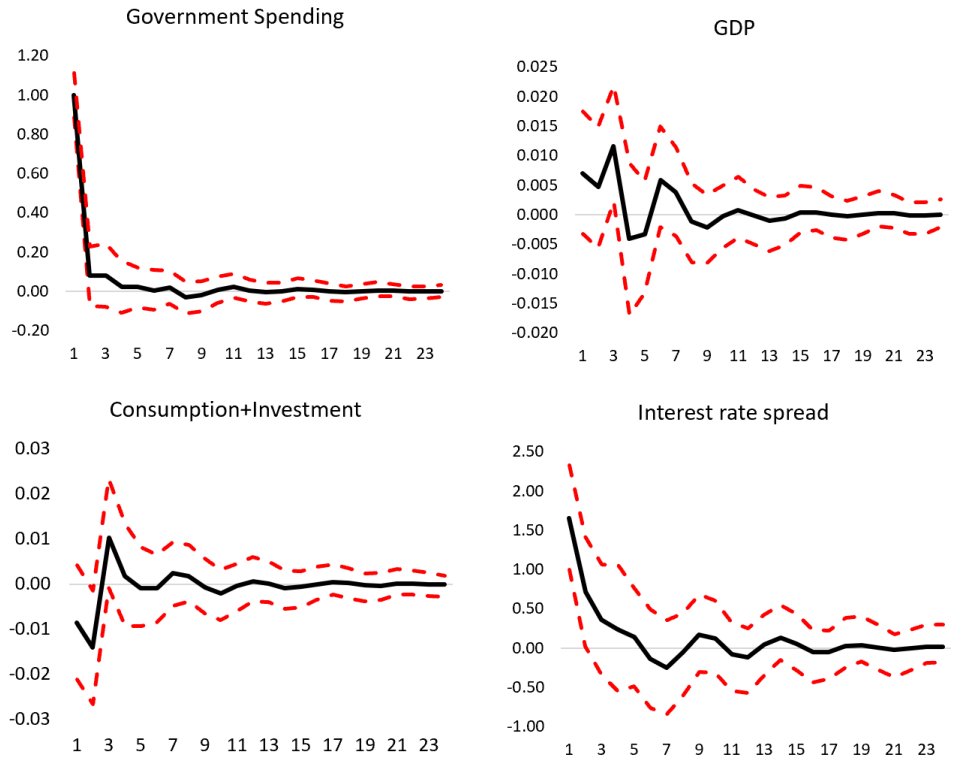
Notes: Impulse response function to a spending shock, author's estimation based on specified VAR. The red dotted lines show 75% bootstrapped confidence intervals.

Figure 2: Responses to a government spending shock

(b) Dominican Republic



(c) Guatemala



Notes: Impulse response function to a spending shock, author's estimation based on specified VAR. The red dotted lines show 75% bootstrapped confidence intervals.

3.2 Model Structure

The relationship between fiscal and monetary policy is studied through the lens of a semi structural macroeconomic model for a small open economy. We propose a model traditionally used for policy analysis (e.g., Berg et al. 2006), where the equations are log-linearized representations of the steady state solution of the structural model.

In this type of models, the baseline specification includes four basic equations: 1) an aggregate demand (IS curve, equation 6), 2) an equation for the inflation rate (a Phillips curve, equation 7), 3) a policy reaction for the monetary policy rate (Taylor rule, equation 2), and, in the case of an open economy model, 4) a real exchange rate determination equation (UIP condition, equation 16). In this framework, the interaction between monetary and fiscal policy comes from fiscal shocks affecting aggregate demand, pushing interest rates, as the central bank stabilizes output gap and inflation.

The novelty of our model is to emphasize the link between fiscal shocks and the market interest rate in the transmission mechanism. Therefore, in addition to their interaction through the aggregate demand, fiscal and monetary policy interact given as higher spending is financed using domestic credit, rising interest rate and crowding out the effects of expansive monetary policy.

Although the model accounts for both the traditional aggregate demand channel and the direct channel through the interest rate determination, the primary objective is to estimate the parameters associated with this direct channel. In this manner, the starting point is to specify the relation between the monetary policy rate and the market rate:

$$i_t^m = i_t^{tpm} + \delta_t, \tag{1}$$

where i_t^m is the market interest rate, i_t^{tpm} is the monetary policy rate set by the central bank and δ_t is the spread between them, which varies over time as observed before.

The monetary policy rate is set by the central bank following an expectation augmented Taylor rule, defined by:

$$i_t^{tpm} = \theta_i i_{t-1}^{tpm} + (1-\theta_i)(\bar{i} + \theta_\pi(E_t\pi_{t+1} - \bar{\pi}) + \theta_{\hat{y}}\hat{y}_t) + \eta_t^{tpm}, \tag{2}$$

where $\bar{i}$ is the steady state interest rate, $E_t\pi_{t+1}$ represents the inflation expectations, $\bar{\pi}$ is the inflation target, $\hat{y}_t$ is the output gap and η_t^{tpm} is the monetary policy shock.

The main addition to the model is the inclusion of an explicit equation for the interest rate spread (δ_t) and its interaction with some key fiscal variables. This can be derived from a New Keynesian model as in Bredemeier et al. (2015) where the nominal marginal rate of inter-temporal substitution exceeds monetary policy rate and is determined endogenously. Therefore, contrary to a traditional model, the nominal marginal rate of inter-temporal substitution is not directly controlled by the central bank.

In their theoretical model, they find that this premium, which accords for the interest rate spread, increases with government spending. This goes in line with the empirical evidence they present, as well as the evidence found by other authors (Dai & Philippon 2005, Kučera et al. 2019). Additional literature points to other variables that explain the interest rate spreads, such as financial conditions and certain macroeconomic variables as GDP or the inflation rate (Amato & Luisi 2006, Were & Wambua 2014, Jorgensen & Apostolou 2013).

To account for this evidence, we model the interest rate spread as follows, using three different fiscal variables:

$$\delta_t = \phi_1^{\delta}\delta_{t-1} + (1-\phi_1^{\delta})\delta_2^{\delta}(fiscal_t) + X\beta + \eta_t^{\delta}, \tag{3}$$

with $fiscal_t$ representing government spending, deficit, or public domestic debt for each one of the different specifications followed. Additionally, $X\beta$ represents the relevant control variables that account for the financial (solvency rate and ratio of non-preforming loans to total loans) and macroeconomic conditions (output gap, inflation, and exchange rate depreciation).

To complete the interest rate block of the model, we specify the real interest rate and its deviation from steady state as follows:

$$r_t = i_t^m - E_t\pi_{t+1}, \tag{4}$$

$$\hat{r_t} = r_t - \bar{r}, \tag{5}$$

where r_t is the real interest rate, which is constructed using the relevant rate for the inter-temporal decision of agents in the economy, i.e., the market interest rate and $\bar{r}$ is the equilibrium real interest rate. Finally, $\hat{r_t}$ represents deviations of the real interest rate from its long-run or steady-state equilibrium values.

The rest of the model follows a traditional structure, with variables in hat representing deviations from steady state and variables with the *ss* subscript representing steady-state values. The aggregate demand is represented by:

$$\hat{y}_t = \beta_1\hat{y}_{t-1} + \beta_2 E_t\hat{y}_{t+1} - \beta_3\hat{r}_t + \beta_4\hat{z}_t + \beta_5\hat{y}_t^* + \beta_6 FI_t + \eta_t^{\hat{y}}, \tag{6}$$

where $\hat{y}_t$ is the output gap, $\hat{z}_t$ is the real exchange rate, $\hat{y}_t^*$ is the foreign output gap, FI_t is a measure of fiscal impulse (see equation 15) and $\eta_t^{\hat{y}}$ is an aggregate demand shock.

A Phillips curve is also included, introducing lagged and expected values of inflation, the output gap, and the real exchange rate, as well as a cost-push shock (η_t^{π}):

$$\pi_t = \alpha_1\pi_{t-1} + \alpha_2 E_t\pi_{t+1} + \alpha_3\hat{y}_t + \alpha_4\hat{z}_t + \eta_t^{\pi}. \tag{7}$$

Given that the fiscal policy plays an important role in the model's dynamics and its interaction with the monetary policy transmission mechanism, we include a fiscal block in our model. In first place, we allow the government spending to be acyclic, following an *AR(1)* process:

$$g_t = \beta_1^g g_{t-1} + (1 - \beta_1^g) g_{ss} + \eta_t^g, \tag{8}$$

with η_t^g representing the government spending shock. On the other side, the tax rate follows a simple rule that allows for smooth changes in the tax rate in response to debt deviations ($\hat{d}_t^T$):

$$t_t = \beta_1^t t_{t-1} + (1 - \beta_1^t) t_{ss} + \beta_2^t \hat{d}_t^T + \eta_t^{tt}. \tag{9}$$

Then, the primary deficit of the government follows:

$$\hat{b}_t = \frac{g_{ss}}{b_{ss}} \hat{g}_t - \frac{t_{ss}}{b_{ss}} \hat{t}_t. \tag{10}$$

The debt accumulation dynamics is divided into its domestic and external components: equation (11) refers to the domestic debt, equation (12) to the external debt and equation (13) to the total debt:

$$\hat{d}_t = \frac{1 + r_{ss}}{1 + g_{ss}^y} (\hat{d}_{t-1} + \hat{i}_t^m - \hat{g}_t^y - \hat{\pi}_t) + \frac{g_{ss}^y - r_{ss}}{1 + g_{ss}^y} \hat{b}_t, \tag{11}$$

$$\begin{aligned} \hat{d}_t^* = \frac{(1 + r_{ss}^*)(1 + \rho_{ss})(1 + \Delta z_{ss})}{1 + g_{ss}^y} (\hat{d}_{t-1}^* + \hat{i}_t^* + (\Delta s_t - (\bar{\pi} - \pi_t^*)) + \hat{\rho}_t - \hat{g}_t^y - \hat{\pi}_t) \\ + (1 - \frac{(1 + r_{ss}^*)(1 + \rho_{ss})(1 + \Delta z_{ss})}{1 + g_{ss}^y}) \hat{b}_t, \end{aligned} \tag{12}$$

$$\hat{d}_t^T = \frac{d_{ss}}{d_{ss}^T} \hat{d}_t + \frac{d_{ss}^*}{d_{ss}^T} \hat{d^*}_t. \tag{13}$$

The fiscal block is completed with the definition for fiscal stance (equation 14) and the fiscal impulse (equation 15):

$$FS_t = \hat{g}_t - \hat{t}_t + \bar{g} \hat{y}_t, \tag{14}$$

$$FI_t = FS_t - FS_{t-1}. \tag{15}$$

Finally, the model includes an external sector to capture the small open economy characteristics of the countries under study. In particular, the model includes the Uncovered

Interest Parity (equation 16), a risk premium component (equation 17), the real exchange rate definition and its gap (equation 18 and 19) and the foreign inflation (equation 20).

$$i_t^m = i_t^* + \Delta E_t S_{t+1} + \rho_t + \eta_t^i, \tag{16}$$

$$\rho_t = (1 - \Theta_\rho)\bar{\rho} + \Theta_\rho \rho_{t-1} + \eta_t^\rho, \tag{17}$$

$$z_t = s_t + p_t^* - p_t, \tag{18}$$

$$\hat{z}_t = z_t - \bar{z}, \tag{19}$$

$$\pi_t^* = (1 - \phi_{\pi^*})\bar{\pi^*} + \phi_{\pi^*}\pi_{t-1}^* + \eta_t^{\pi^*}. \tag{20}$$

4 Estimation

We estimate model's parameters using Bayesian methods. There is a vast literature that discusses the application of Bayesian techniques to the estimation of the state – space representation of structural and semi-structural models (Ruge-Murcia 2007, Fernández-Villaverde 2010, Ireland 2004, among others). The consideration of extra-sample or "prior" information about the probable values for model's parameters is one of the main features of this statistical inference method. In the Bayesian perspective, parameters are interpreted as random variables, where the joint distribution considers information about model structure, data and the a priori probabilistic distribution of unknown parameters.

The estimation is carried out for the cases of Costa Rica, the Dominican Republic and Guatemala. These countries are developing economies where monetary policy is implemented by central banks with explicit inflation targeting regimes, but with a strong weight on exchange rate volatility in their objective functions and an increasing domestic market of public debt.

Each model is estimated using as observable 10 domestic variables: gross domestic product (GDP), consumer price index (CPI), nominal exchange rate (NER), monetary policy rate (MPR), commercial bank's interest rate, primary deficit, domestic public debt, public expenditure, commercial bank's non-performing loans and solvency ratio. As foreign variables, we include: US CPI, GDP, Fed Funds rate and EMBI as a proxy of sovereign risk.

Table (1) shows prior distributions and information about the posterior distribution of model's parameters for the mentioned economies. Tables (2), (3) and (4) present the estimation of the interest rate spread by country, considering alternatives fiscal indicators,

as we are especially interested in the elasticity of interest rate spread to fiscal indicators.

In all three countries, the observed data provides relevant information to update the coefficients estimates on the fiscal variables, especially on the case where the debt is used as the fiscal stance variable. The financial conditions indicators, with few exceptions, do not seem to have enough information to update the posterior mode, since they normally fell in the proximity of the prior value. In the Appendix A we present the estimated distribution of the posteriors and some convergence diagnostics.

5 Simulations

Considering the model structure and parameters' estimation presented above, we conduct a counterfactual simulating the response of domestic variables to a fiscal shock, in two scenarios: one where there is interaction among the fiscal variable and the interest rate spread and another one where there is no interaction.

We compare the results of the simulations of the base model as described in Section 4 (using the primary deficit as the relevant fiscal indicator) with an alternative model in which the fiscal variable is excluded from the interest rate spread equation. Figure (A2) presents the simulations of a government spending shock for all three economies. The simulations show a similar dynamic in all countries, with some variation in terms of the magnitude of the changes.

In the case with no interaction between the deficit and the interest rate spread (red lines in Figure A2), the increase in government spending drives up aggregate demand and increases the output gap, driving inflation up and prompting the central bank to rise its monetary policy rate to influence the market interest rate. The increase in the market interest rate, and therefore on the real rate, drags aggregate demand down reducing the output gap while the inflation returns to its equilibrium. As expected, the increase in government spending translates into a higher deficit which ends up rising the government debt.

The scenario is different when the interest rate spread reacts to this increase in the government spending and its effect on the deficit, given that, as presented in the VAR evidence, the reaction of the interest rate spread to government spending is statistically relevant. In this case, the interest rate spread rises with the increasing deficit, driving up the market interest rate, appreciating the real exchange rate and reducing inflation. Contrary to the previous case, the central bank needs to compensate the spread's increase by reducing its policy rate to bring down market interest rate. Additionally, the effect of the spread on the market interest rate reduces the output gap, reversing part of the gains in output due to the expansionary fiscal policy. Finally, the debt-to-GDP ratio increase is higher in this scenario as a result of the increase on the cost of debt inflicted by the higher interest rate.

Table 1: Estimated Parameters

Equations	Prior			Posterior					
				Costa Rica		Dom. Rep.		Guatemala	
	Distribution	Mean	S.D.	Mode	S.D.	Mode	S.D.	Mode	S.D.
1. IS curve									
Lagged Output Gap	Beta	0.50	0.10	0.78	0.06	0.76	0.04	0.56	0.07
Lead Output Gap	Gamma	0.05	0.01	0.05	0.01	0.05	0.01	0.05	0.01
Interest Rate Gap	Gamma	0.15	0.05	0.09	0.03	0.15	0.04	0.14	0.05
RER Gap	Gamma	0.05	0.01	0.05	0.01	0.05	0.01	0.05	0.01
Foreign Output Gap	Gamma	0.10	0.01	0.10	0.01	0.10	0.01	0.10	0.01
Fiscal Impulse	Gamma	0.10	0.01	0.10	0.01	0.10	0.01	0.10	0.01
2. Phillips Curve									
Lagged Inflation	Beta	0.40	0.10	0.38	0.04	0.24	0.05	0.30	0.05
Output Gap	Gamma	0.05	0.01	0.05	0.01	0.05	0.01	0.05	0.01
RER Gap	Gamma	0.10	0.05	0.15	0.07	0.08	0.05	0.08	0.04
3. Monetary Policy Rule									
Lagged MPR	Beta	0.70	0.10	0.84	0.02	0.70	0.75	0.82	0.03
Expected Inflation	Gamma	1.50	0.10	1.48	0.10	1.50	1.48	1.47	0.10
Output Gap	Gamma	0.40	0.10	0.42	0.10	0.40	0.33	0.37	0.10
4. Interest Rate Spread									
Lagged Spread	Beta	0.50	0.10	0.60	0.08	0.60	0.08	0.59	0.11
GDP Volatility	Gamma	0.10	0.05	0.07	0.04	0.08	0.04	0.07	0.04
Solvency Ratio	Gamma	0.10	0.05	0.08	0.04	0.08	0.04	0.07	0.04
Inflation Volatility	Gamma	0.10	0.05	0.06	0.03	0.05	0.03	0.04	0.02
NER Volatility	Gamma	0.10	0.05	0.05	0.02	0.04	0.02	0.05	0.03
Non Performing Loans (NPL)	Gamma	0.10	0.05			0.08	0.04	0.07	0.04
5. Fiscal Block									
Fiscal Expenditure	Beta	0.60	0.10	0.68	0.07	0.43	0.08	0.55	0.08
Lagged Tax/GDP in Tax Rule Eq.	Beta	0.10	0.05	0.66	0.12	0.45	0.09	0.56	0.09
Deficit in Tax Rule Equation	Gamma	0.70	0.10	0.04	0.02	0.03	0.02	0.02	0.01
6. AR(1) for Exogenous Variables									
Solvency Ratio	Beta	0.50	0.10	0.63	0.08	0.63	0.07	0.66	0.07
NPL	Beta	0.50	0.10			0.54	0.07	0.56	0.08
Foreign Inflation	Beta	0.50	0.10	0.48	0.10	0.50	0.10	0.50	0.10
Foreign Interest Rate	Beta	0.50	0.10	0.50	0.11	0.49	0.10	0.50	0.11
Foreign Output Gap	Beta	0.50	0.10	0.85	0.03	0.85	0.03	0.85	0.03
Risk Premium	Beta	0.50	0.10	0.50	0.11	0.49	0.10	0.50	0.11
6. Standard Deviation of Shocks									
S.D. Aggregate Demand	Inv. Gamma	0.05	Inf	0.01	0.00	0.01	0.00	0.01	0.00
S.D. Cost Push	Inv. Gamma	0.05	Inf	0.03	0.00	0.04	0.00	0.02	0.00
S.D. Monetary Policy	Inv. Gamma	0.05	Inf	0.01	0.00	0.02	0.00	0.01	0.00
S.D. Spread	Inv. Gamma	0.05	Inf	0.01	0.00	0.01	0.00	0.01	0.00
S.D. Solvency Ratio	Inv. Gamma	0.01	Inf	0.00	0.00	0.00	0.00	0.00	0.00
S.D. NPL	Inv. Gamma	0.01	Inf			0.01	0.00	0.00	0.00
S.D. Fiscal Expenditure	Inv. Gamma	0.05	Inf	0.02	0.00	0.02	0.00	0.01	0.00
S.D. Tax/GDP	Inv. Gamma	0.05	Inf	0.03	0.00	0.04	0.00	0.02	0.00
S.D. UIP	Inv. Gamma	0.05	Inf	0.02	0.00	0.02	0.00	0.02	0.00
S.D. Risk Premium	Inv. Gamma	0.05	Inf	0.02	0.01	0.02	0.01	0.02	0.00
S.D. Foreign Inflation	Inv. Gamma	0.05	Inf	0.05	0.01	0.03	0.01	0.03	0.01
S.D. Foreign Interest Rate	Inv. Gamma	0.05	Inf	0.02	0.01	0.02	0.01	0.02	0.00
S.D. Foreign Output Gap	Inv. Gamma	0.05	Inf	0.01	0.00	0.01	0.00	0.01	0.00
S.D. Debt/GDP	Inv. Gamma	0.05	Inf	0.34	0.03	0.18	0.02	0.14	0.01

Notes: Summary of estimated parameters by Bayesian methods.

Table 2: Dominican Republic: Estimation results for the interest rate spread equation

				Specifications								
	Prior			(1)			(2)			(3)		
Fiscal Indicators	**Distribution**	**Mean**	**S.D.**	**Mode**	**90% HPD interval**		**Mode**	**90% HPD interval**		**Mode**	**90% HPD interval**	
Public Expenditure	Gamma	0.1	0.05	0.066	0.016	0.108						
Primary Deficit	Gamma	0.1	0.05				0.094	0.031	0.155			
Domestic Debt	Gamma	0.1	0.05							**0.009**	0.003	0.014
Controls												
Financial Conditions												
Solvency ratio	Gamma	0.1	0.05	0.107	0.028	0.181	0.095	0.024	0.173	0.089	0.025	0.155
Non Performing Loans	Gamma	0.1	0.05	0.095	0.021	0.161	0.099	0.030	0.166	0.099	0.019	0.172
Δ Output gap	Gamma	0.1	0.05	0.099	0.018	0.162	0.098	0.032	0.169	0.096	0.026	0.163
Δ Inflation	Gamma	0.1	0.05	0.063	0.020	0.112	0.063	0.013	0.104	0.055	0.015	0.093
Δ NER depreciation	Gamma	0.1	0.05	0.055	0.014	0.095	0.051	0.015	0.085	0.047	0.014	0.078

Notes: Table shows the results of the estimation for the interest rate spread equation under different specifications of the fiscal indicator.

Table 3: Costa Rica: Estimation results for the interest rate spread equation

				Specifications								
	Prior			(1)			(2)			(3)		
Fiscal Indicators	**Distribution**	**Mean**	**S.D.**	**Mode**	**90% HPD interval**		**Mode**	**90% HPD interval**		**Mode**	**90% HPD interval**	
Public Expenditure	Gamma	0.1	0.05	0.093	0.023	0.161						
Primary Deficit	Gamma	0.1	0.05				**0.052**	0.013	0.091			
Domestic Debt	Gamma	0.1	0.05							**0.008**	0.003	0.012
Controls												
Financial Conditions												
Solvency ratio	Gamma	0.1	0.05	0.101	0.023	0.166	0.106	0.030	0.184	0.095	0.025	0.161
Δ Output gap	Gamma	0.1	0.05	0.080	0.027	0.135	0.095	0.020	0.167	0.086	0.023	0.146
Δ Inflation	Gamma	0.1	0.05	0.070	0.021	0.130	0.074	0.015	0.128	0.071	0.020	0.124
Δ NER depreciation	Gamma	0.1	0.05	0.055	0.014	0.093	0.051	0.018	0.082	0.053	0.019	0.089

Notes: Table shows the results of the estimation for the interest rate spread equation under different specifications of the fiscal indicator.

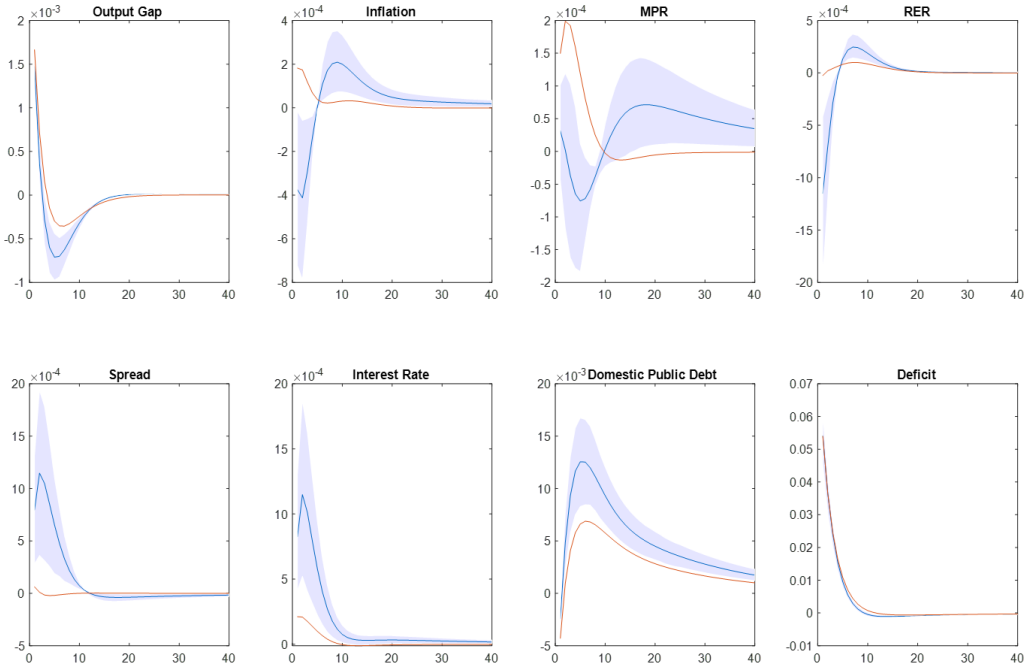
Table 4: Guatemala: Estimation results for the interest rate spread equation

				Specifications								
	Prior			(1)			(2)			(3)		
Fiscal Indicators	**Distribution**	**Mean**	**S.D.**	**Mode**	**90% HPD interval**		**Mode**	**90% HPD interval**		**Mode**	**90% HPD interval**	
Public Expenditure	Gamma	0.1	0.05	0.075	0.025	0.128						
Primary Deficit	Gamma	0.1	0.05				0.103	0.030	0.178			
Domestic Debt	Gamma	0.1	0.05							**0.009**	0.003	0.015
Controls												
Financial Conditions												
Solvency ratio	Gamma	0.1	0.05	0.091	0.024	0.157	0.092	0.022	0.156	0.092	0.023	0.152
Non Performing Loans	Gamma	0.1	0.05	0.093	0.027	0.160	0.096	0.025	0.161	0.100	0.022	0.168
Δ Output gap	Gamma	0.1	0.05	0.091	0.029	0.149	0.099	0.024	0.163	0.098	0.036	0.157
Δ Inflation	Gamma	0.1	0.05	0.059	0.015	0.099	0.055	0.019	0.093	0.061	0.015	0.105
Δ NER depreciation	Gamma	0.1	0.05	0.064	0.011	0.112	0.063	0.020	0.111	0.069	0.023	0.120

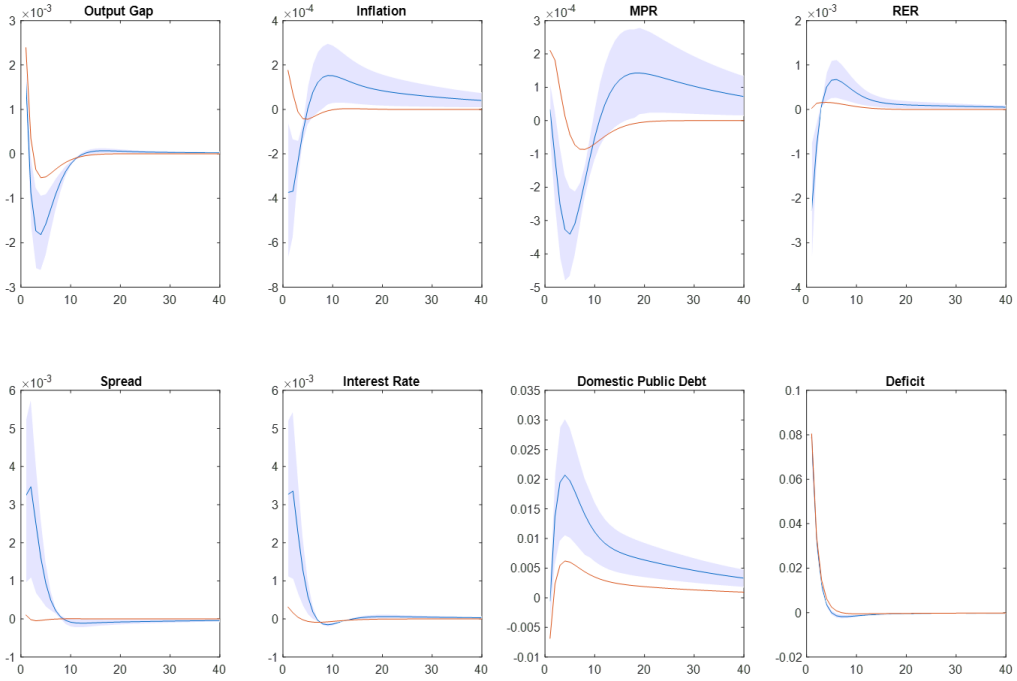
Notes: Table shows the results of the estimation for the interest rate spread equation under different specifications of the fiscal indicator.

Figure 3: Simulated response to a government spending shock

(a) Costa Rica



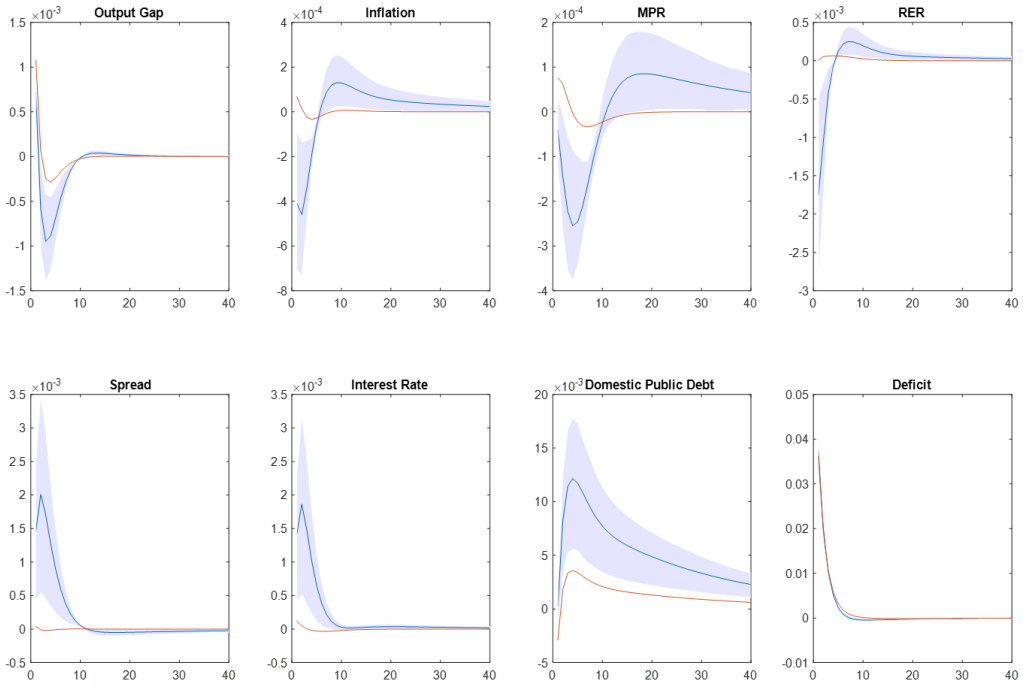
(b) Dominican Republic



Notes: Blue lines show the simulated response in the base model with interaction between fiscal policy and interest rate spread, while the red line indicates the alternate model without this interaction.

Figure 3: Simulated response to a government spending shock

(c) Guatemala



Notes: Blue lines show the simulated response in the base model with interaction between fiscal policy and interest rate spread, while the red line indicates the alternate model without this interaction.

6 Concluding Remarks

In the last decades, countries have understood the importance of central bank independence from government fiscal financing needs. Recently, the research has turned to the interaction between these policies in the economy and the impact each one has on their policy objectives.

This paper analyses the role of government fiscal policy on the interest rate determination and its effect on the monetary policy transmission mechanism. The empirical evidence presented here for Costa Rica, Dominican Republic and Guatemala supports the claim that expansionary fiscal policy increases the market interest rate even if the monetary policy rate is unchanged.

Supported by this evidence, we use a semi-structural macroeconomic model that includes this interest rate determination dynamics and estimate its parameters using data for the three countries. We then use these estimations to produce simulated responses to fiscal shocks with two scenarios: one with the interaction between fiscal variables and interest rate and one without such feature. Our results show that fiscal expansion has less effect on the output gap when the interest rate spread reacts to the fiscal deficit and, in fact, reverses part of the gains in terms of GDP, due to the effect this fiscal expansion

has on the market interest rate.

There are several ways to expand this research approach. Many countries have had different fiscal regimes in the last decade when many have tried to consolidate their public finances. One possible extension is to estimate a model that explicitly includes some regime switching structure to capture differences in the parameters estimated values in distinct fiscal regimes. Another possible approach to follow in future research is to propose a full structural model that takes into consideration a more solid micro foundation to capture the effects of fiscal policy on the financial markets.

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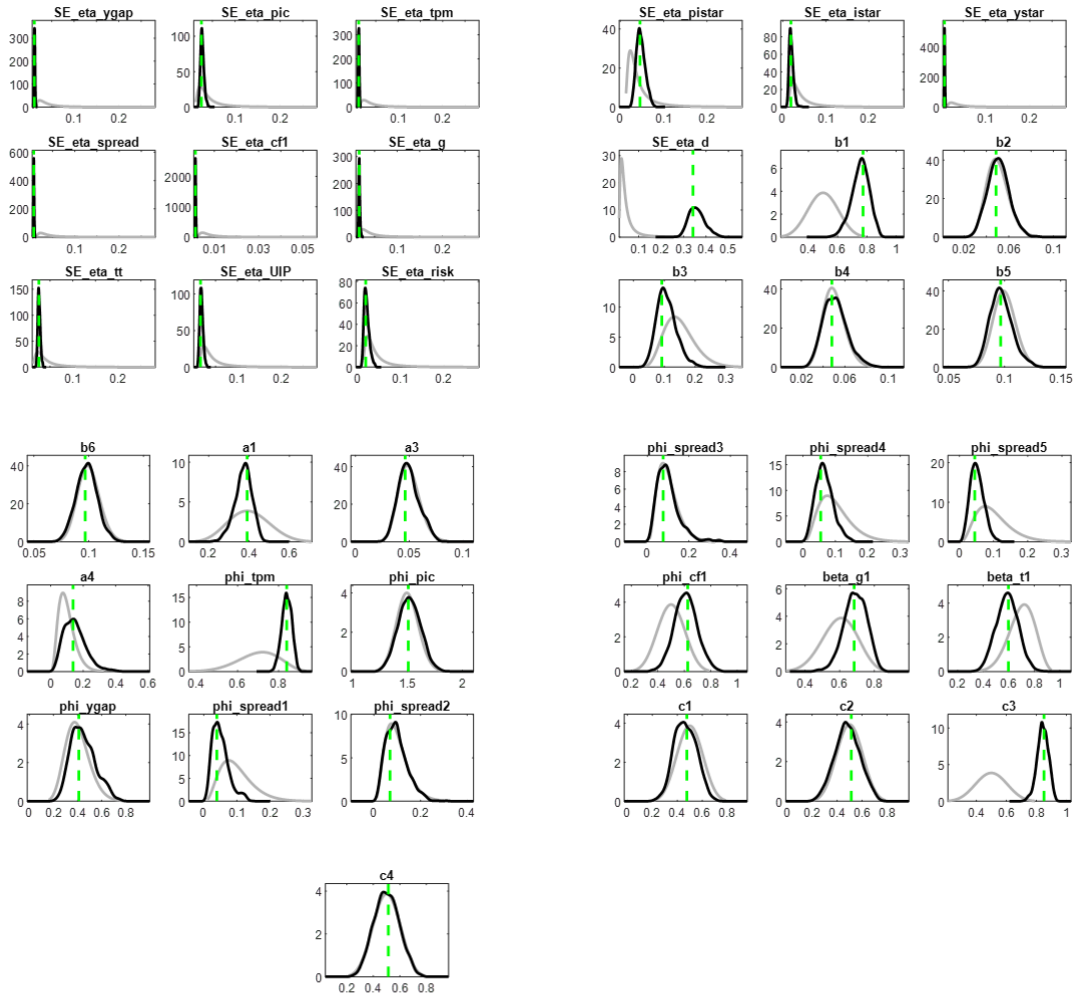
Appendix

A Estimation Results and Convergence Diagnostics

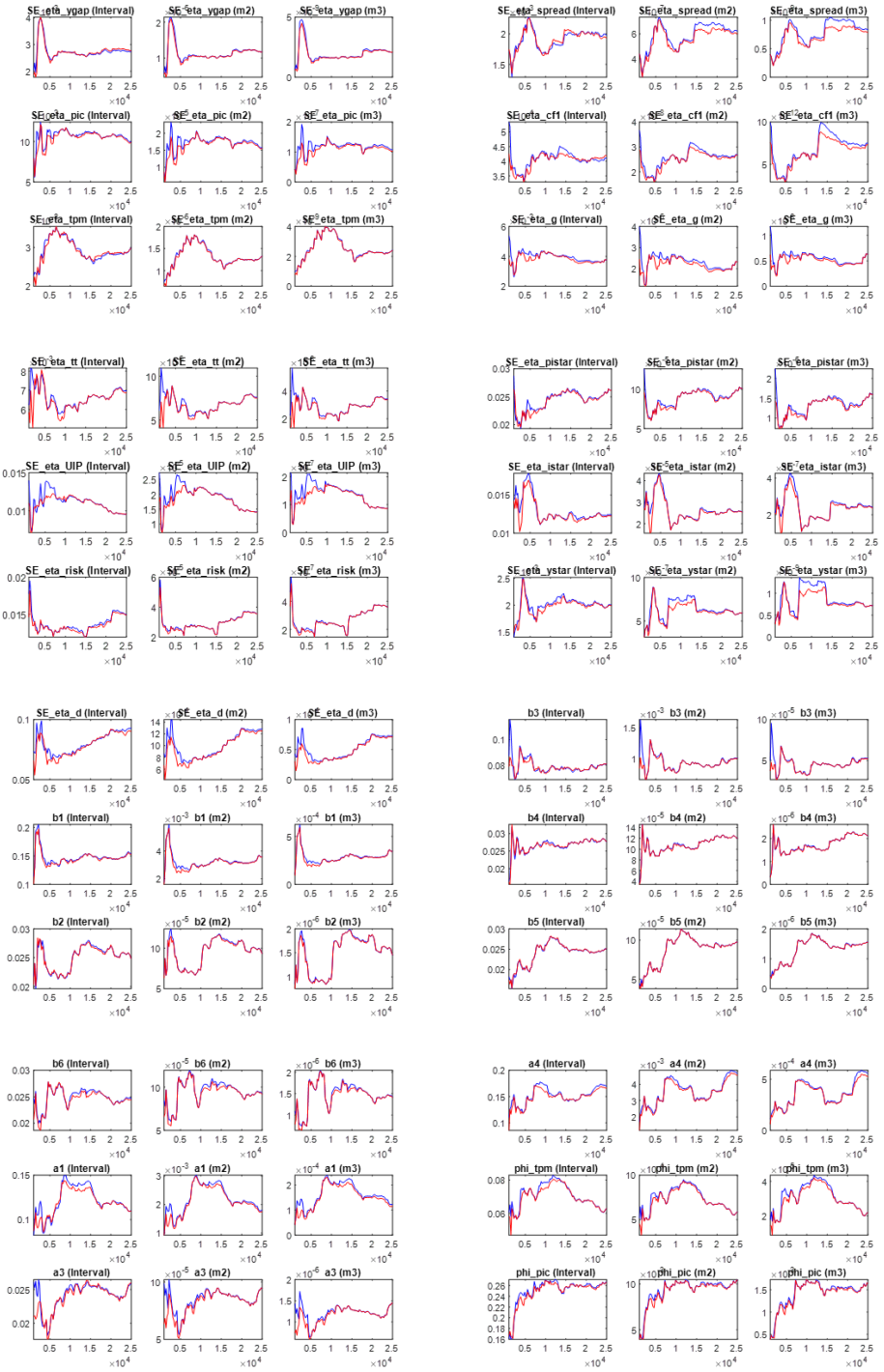
A.1 Costa Rica

Figure A1: Priors and posteriors estimation



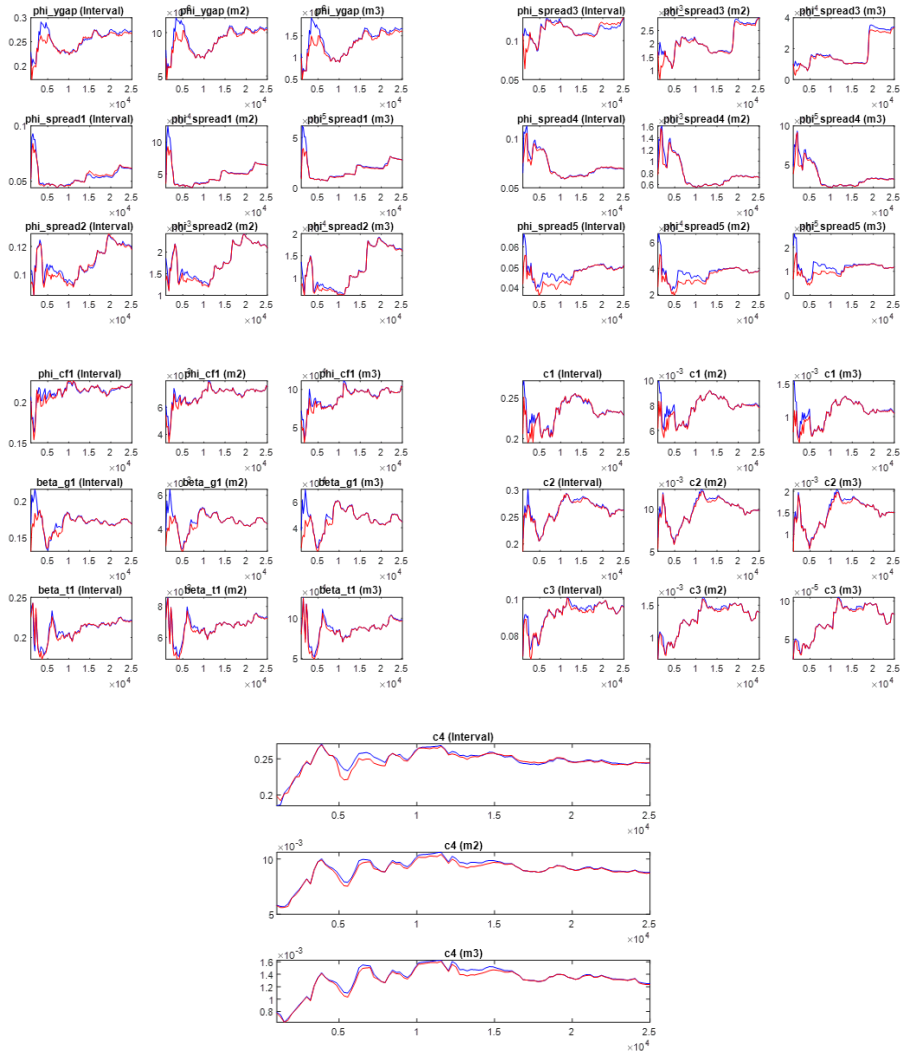
Notes: Priors and posteriors distribution for all parameters.

Figure A2: Convergence Diagnostics



Notes: MCMC uni-variate convergence diagnostic for all parameters.

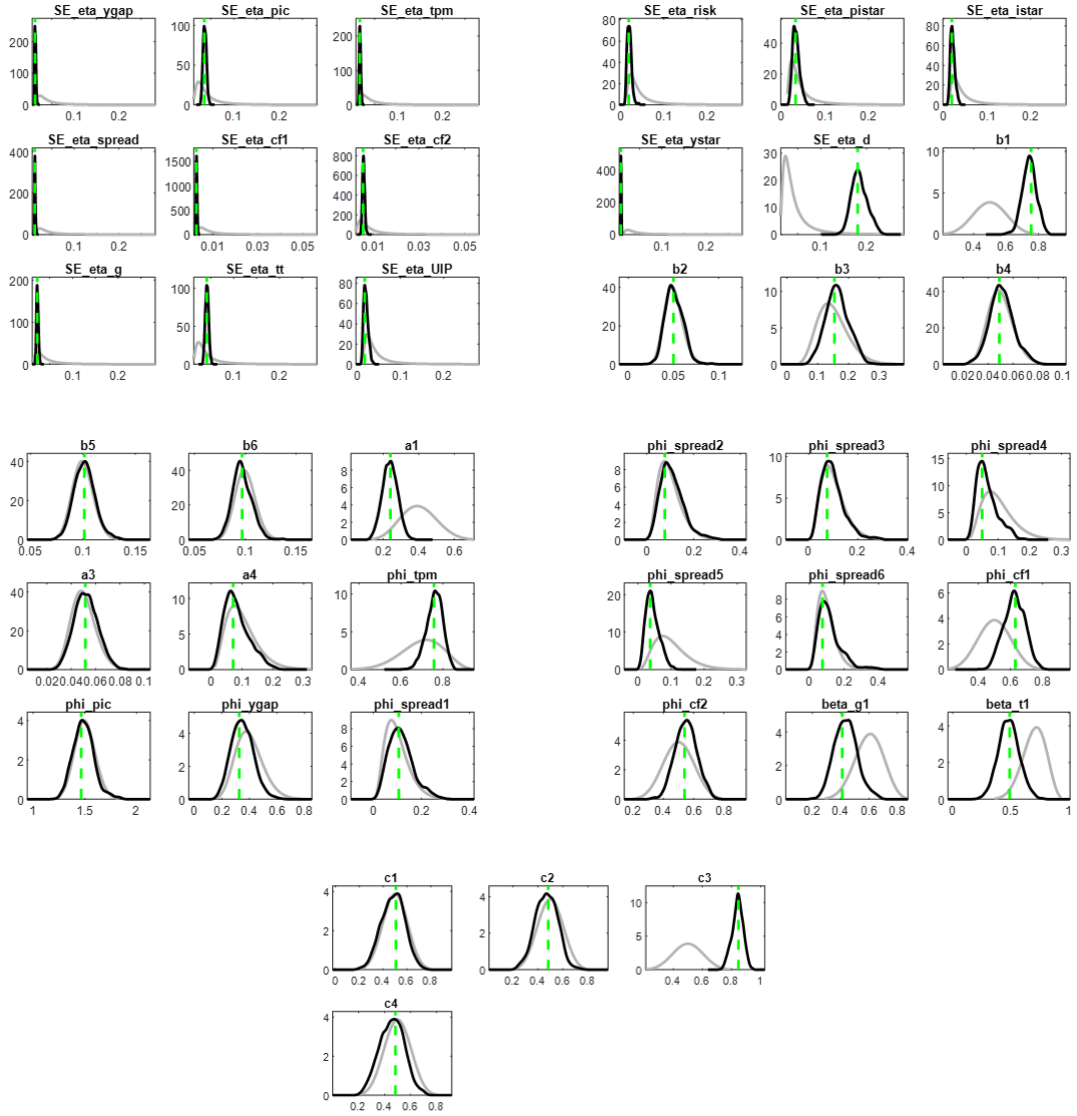
Figure A2: Convergence Diagnostics



Notes: MCMC uni-variate convergence diagnostic for all parameters.

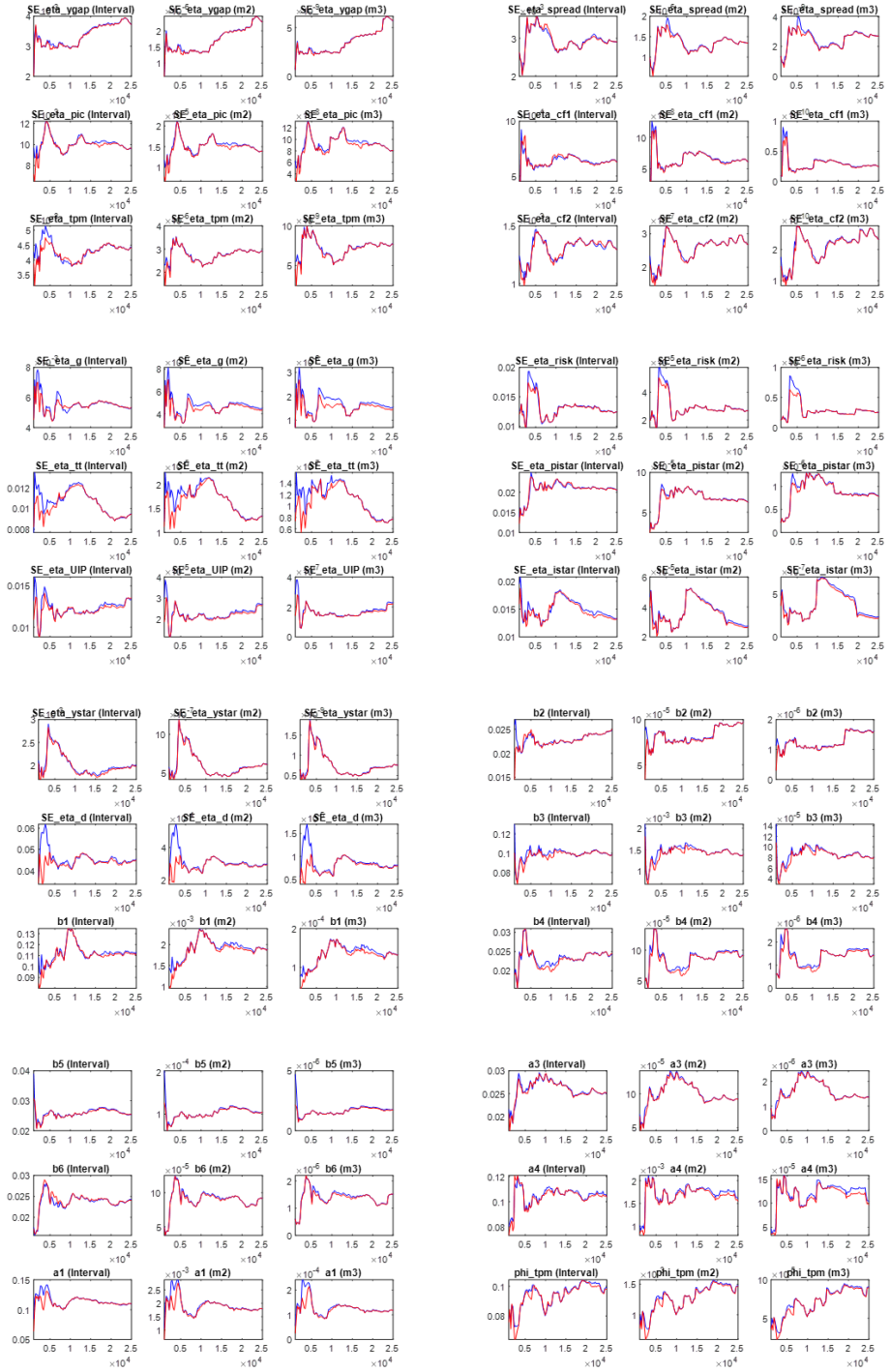
A.2 Dominican Republic

Figure A3: Priors and posteriors estimation



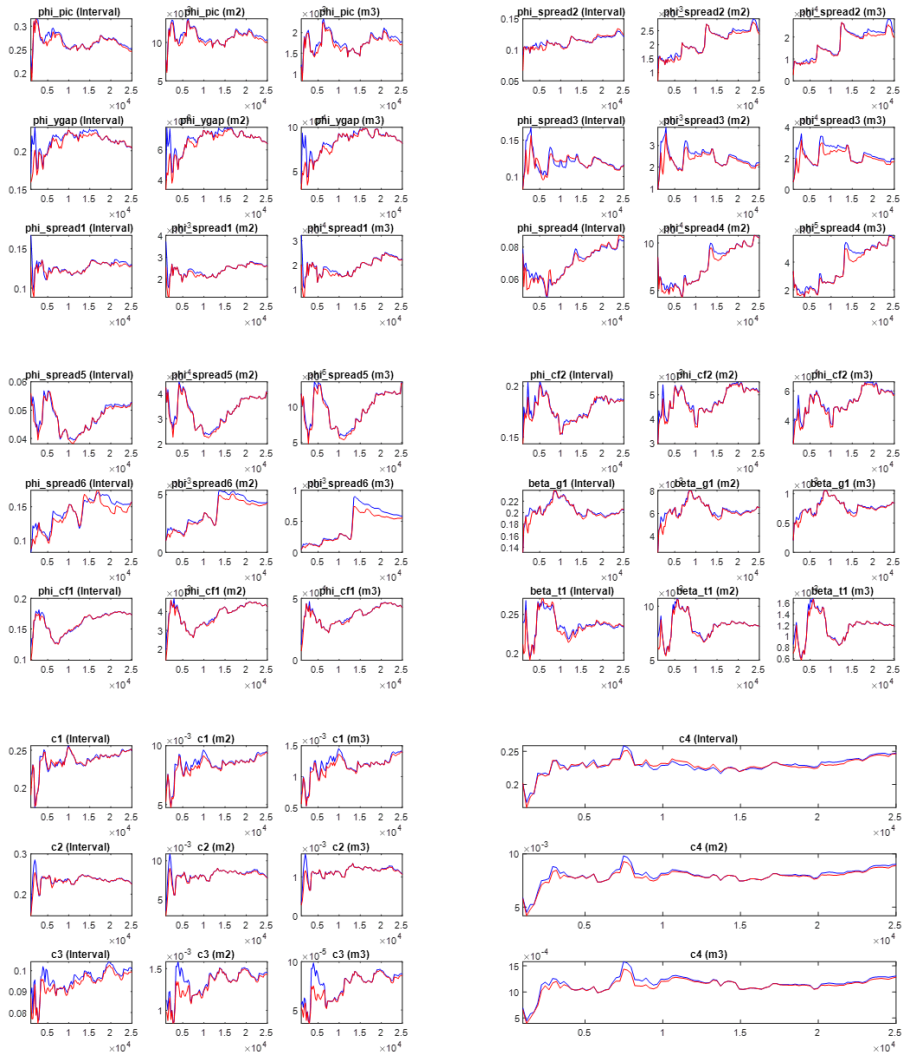
Notes: Priors and posteriors distribution for all parameters.

Figure A4: Convergence Diagnostics



Notes: MCMC uni-variate convergence diagnostic for all parameters.

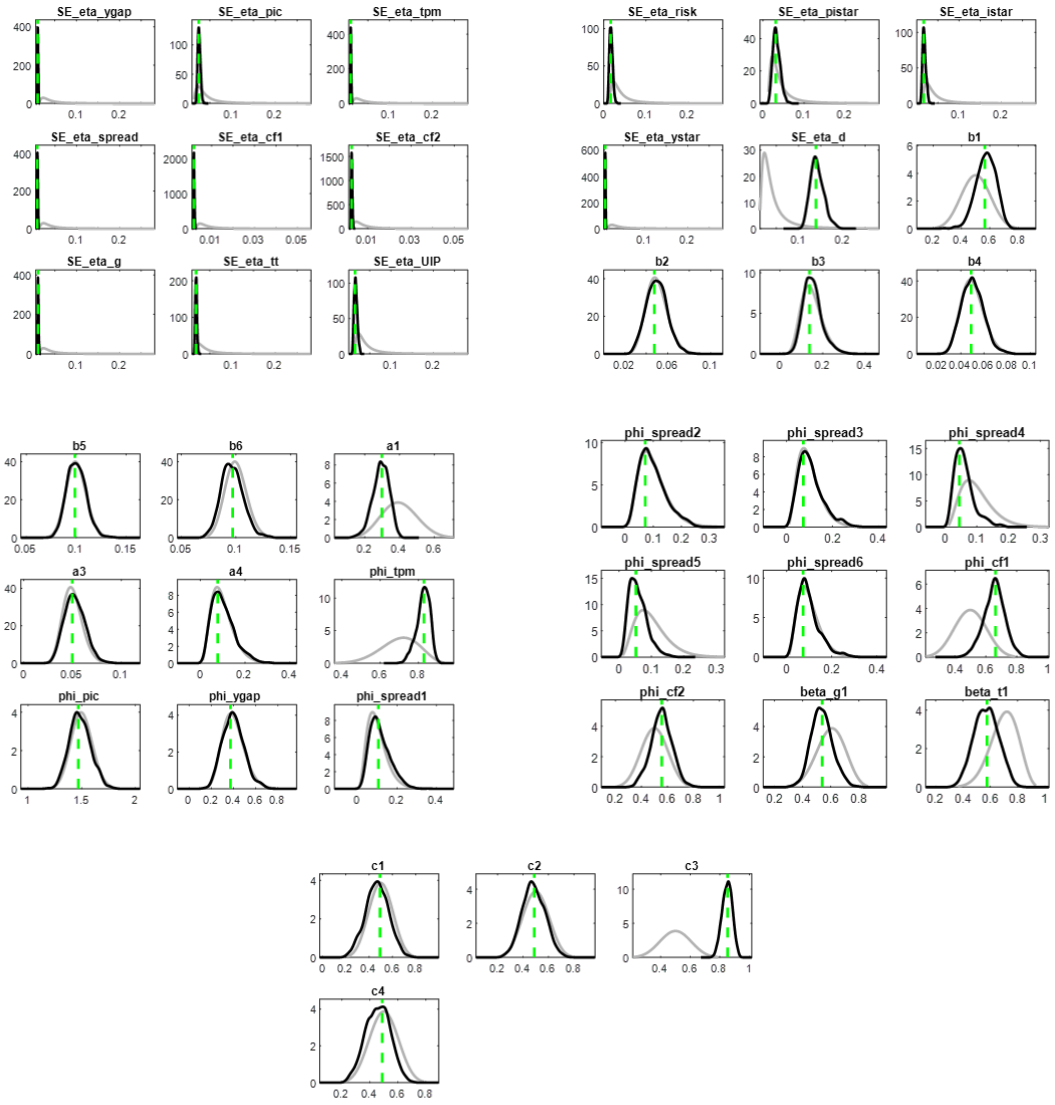
Figure A4: Convergence Diagnostics



Notes: MCMC uni-variate convergence diagnostic for all parameters.

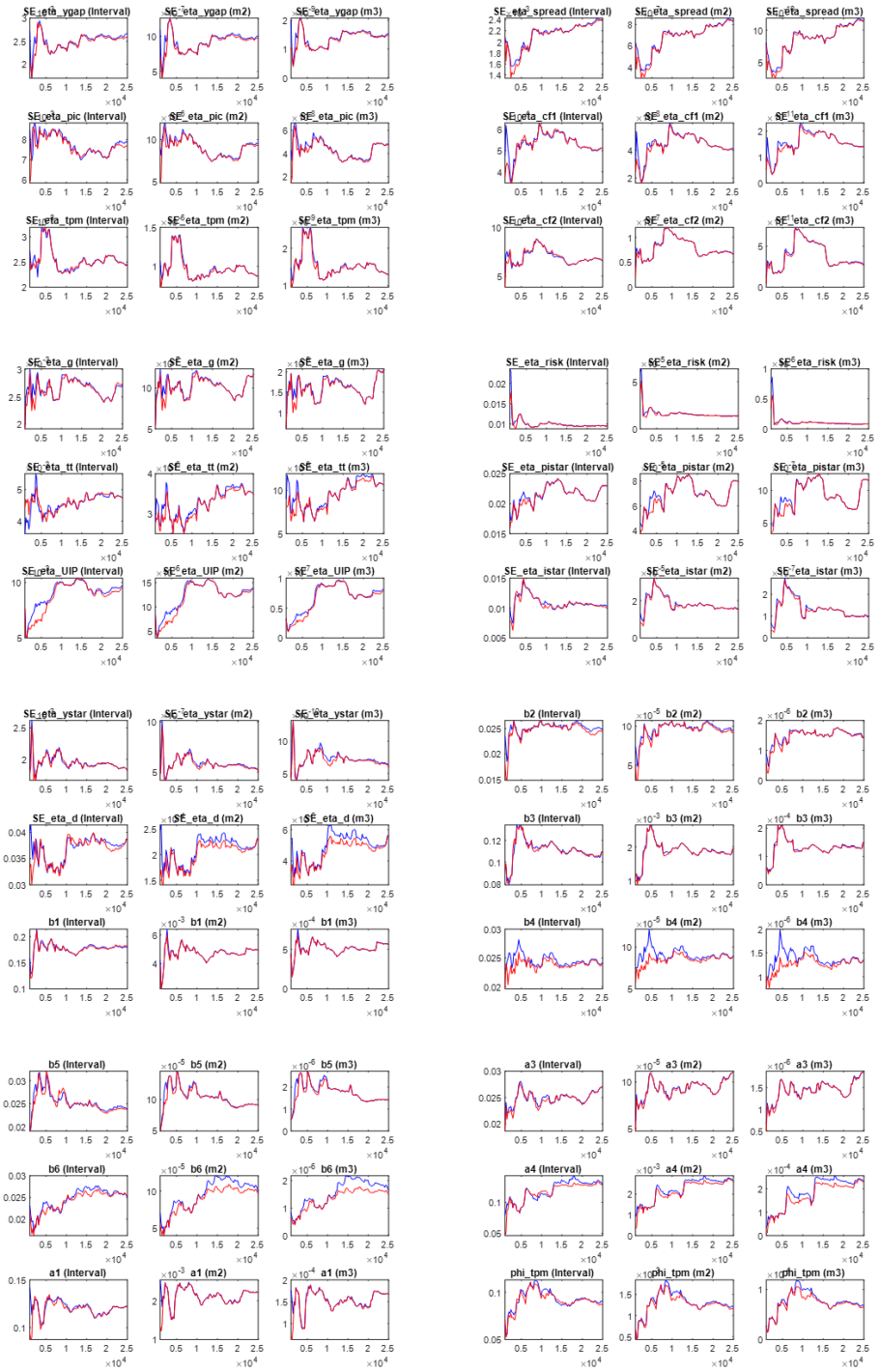
A.3 Guatemala

Figure A5: Priors and posteriors estimation



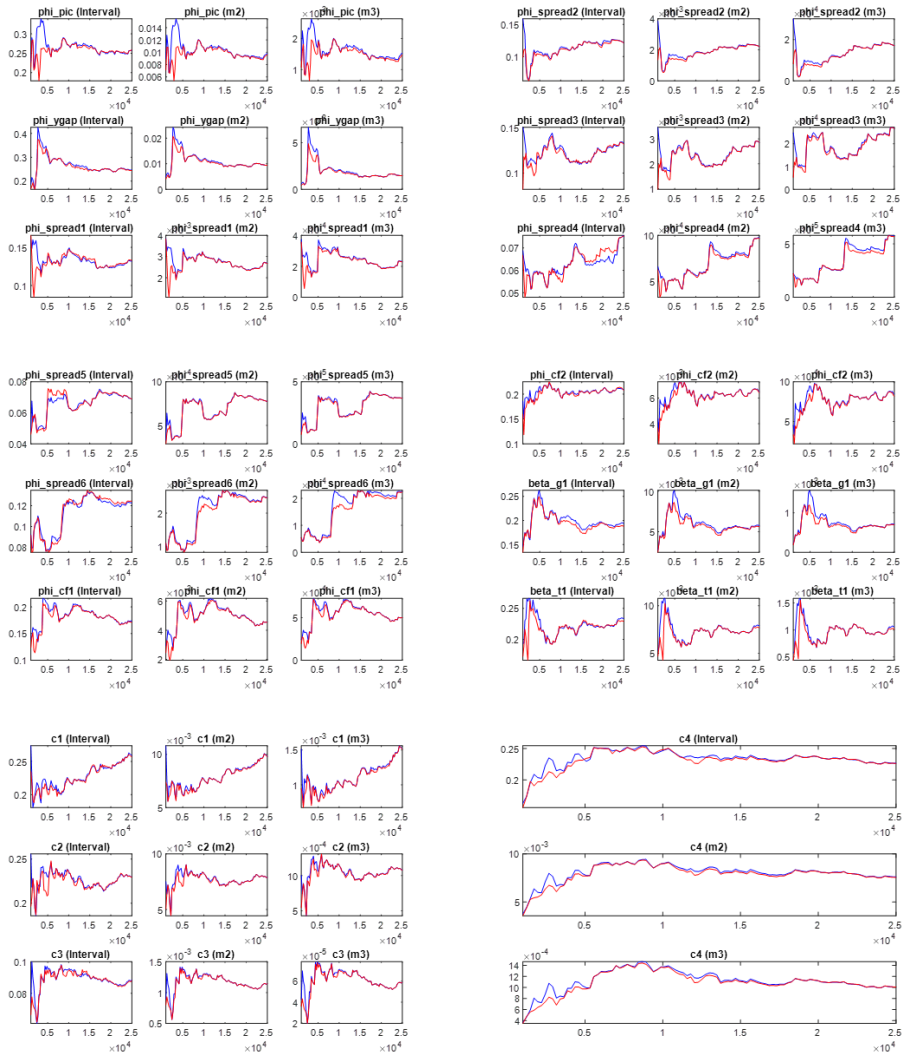
Notes: Priors and posteriors distribution for all parameters.

Figure A6: Convergence Diagnostics



Notes: MCMC uni-variate convergence diagnostic for all parameters.

Figure A6: Convergence Diagnostics



Notes: MCMC uni-variate convergence diagnostic for all parameters.