International Reserve and Cryptocurrencies: Is There Hedging Effect?*

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Abstract

In April 2022, the total market capitalization of cryptocurrencies reached over 2 trillion U.S. dollars, roughly 100% of the monetary base of the United States (M2). Financial technology (Fintech) is increasing by enabling to automate the financial transactions. Using the dataset from Bloomberg and Federal Reserve Economic Data (FRED), covering from January 2008 to June 2019, I assessed the hedging effect of holding Bitcoin as a fraction of the international reserve. Based on the evidence from Time-Varying Parameter VAR, I confirm a diversification benefit in keeping a Bitcoin as a part of the reserve. Further, I have accounted for the possible regime-switching in residual variance by incorporating the Markov Switching Model and confirming the findings.

Keywords: *Fintech, International Reserve, Time Series, Growth*

JEL Codes: *C22, G01, G11, Q58*

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1 Introduction

Larger fiscal deficits have historically concurred with inefficient government expenditures (Afonso et al. 2005; Afonso and Jalles 2014). Fiscal deficits arise when government expenditures exceed its tax revenue in a persistent manner. They also translate into a surge in public debt that typically occurs during periods of economic turmoil. Allocation of fiscal spending is a more crucial decision under recession to mitigate the economic downturn, therefore understanding the impact of usage of government revenue, primarily stemming from tax or additional public debt, on economic growth is of particular interest among researchers. To address this issue in a general framework, we construct an endogenous growth model based on Bruce and Turnovsky (1999). We then follow up by analyzing the resulting empirical nuances by applying Bayesian Model Averaging, a novel technique in this context. The approach of incorporating the model uncertainties in the empirical analysis is generally superior to relying on any single model (Raftery 1995; Draper 1995; Fernandez et al. 2001; Eicher and García-Peñalosa 2008; Eicher et al. 2011; Asatryan and Feld 2015). Therefore, this step is considered innovative since erstwhile results regarding the usage of government revenues for growth are contradictory, stemming primarily from the diverse focus of country sets, lack of model uncertainty incorporation, and improper assessment of disaggregated government revenue/expenditure.

Literature in government expenditure on growth typically selects a single model based on different criteria. The inferences based on the selected model thereby disregards the empirical uncertainty in the model selection approach. The different approaches to modeling have led to diverse implications for the relationship between government expenditure and economic growth. Chen et al. (2017) is one of recent literature that dealt with the topic of government expenditure on growth. They analyze a panel smoothing transitional regression (PSTR) model with flexible parameters to incorporate the heterogeneity among countries across time. They found a possible positive relationship between debt and infrastructure investment on growth as long as the government holds below the threshold; 59.72% debt to GDP ratio and 20.04% public investment to GDP ratio. They show that once public investment hits this threshold or exceeds it, there will be a subsequent negative response to growth (crowding-out effect). Agell et al. (2006) controlled for simultaneity and sample-selection bias before demonstrating that the relationships between government expenditure and tax to GDP ratio on growth are not robust when the initial level of GDP and demographic factors are controlled. To accommodate possible intercountry heterogeneities in structural forms of nature, Dar and AmirKhalkhali (2002) deploy a random coefficient model. They proceed to demonstrate that total government expenditure significantly negatively impacted growth across the year, 1971-1999. Afonso and Furceri (2010) consider IV-estimates to deal with potential endogeneity and reverse causality in the model to claim that the share of government revenue and spendings are detrimental to growth. There is considerable work that accounts for GMM and/or fixed effects to rule out the potential omitted variable bias. They have largely found a negative relationship (occasionally non-significant) between government expenditure and growth (Miller and Russek 1997; Bellettini and Ceroni 2000; Afonso and Jalles 2013). Even though their selection of IV is transparent, lagged IV approach may potentially bring bias by increasing RMSE, thereby skyrocketing the type I error when a lagged explanatory variable has some form of a causal relationship with the dependent variable (Wang and Bellemare 2019). Various stylized results have emphasized that if the government expenditure is used specifically for public investment, there will be a significant positive response in the medium to long run (Romero-Avila and Strauch 2008; Furceri and Li 2017). On the aspect of government consumption, a vast literature conclude that government consumption negatively affects growth (Cameron 1982; Landau 1986; Hansson and Henrekson 1994; Arin et al. 2019). These findings highlight the importance of decomposing government expenditure and monitor them closely at the same time.

On the topic of taxation policies, Romer and Romer (2010) found that a tax increase of 1 percent of GDP reduces output by nearly three percent over the subsequent next three years based on their novel measure of fiscal shocks, while Mendoza et al. (1997) found insignificant quantitative response of tax policy on growth based on their theoretical and empirical approaches thereby suggesting its ineffectiveness. On the contrary in the sphere of public debt, Reinhart and Rogoff (2010) claim that there exists potential negative relationship between debt and growth post 90% debt to GDP ratio, while Panizza and Presbitero (2014) use an IV approach to identify public debt shocks and conclude that there is a negative correlation between public debt and real GDP growth for OECD countries, but that the link disappears once endogeneity issues are corrected. Vast literature so far show debt is generally detrimental to economic growth (Myers 1977; Cecchetti et al. 2011; Soyres et al. 2022). While literature that assesses tax and debt individually reveal a certain indicator for growth, we think that tax and public debt need to be analyzed simultaneously since these are interlinked in the context of the fiscal policy perspective. This is not only feasible but also important because whenever governments want to increase expenditure, they face trade offs in deciding whether to increase tax or issue additional borrowings.

As we see from previous discussion, existing literature so far implicitly assume not only the existence of "true model", but also rule out different potential model candidates that have been considered in the literature. To deal with the model uncertainties that underpin the diverse findings, we take an initiative to address this issue by using Bayesian Model Averaging. One of the earlier empirical works that incorporated model uncertainty in growth literature is Sala-i Martin (1997) who analyzed growth determinants using Bayesian Averaging over Classical Estimates (BACE) and showed 67 determinants that may influence economic growth. Bergh and Karlsson (2010) then comprehensively assess the growth effects of fiscal policy. They address the relationship based on OECD panel data using Bayesian Averaging over Classical Estimates (BACE) analysis to deal with model uncertainty. They have found a negative correlation between the size of government and the economy's growth rate. While their findings are remarkable in highlighting an important remedy for negative growth stemming from increase in government expenditure through further economic openness and sound policies, they do not account for the disaggregation of government expenditure that may have opposing implications for growth as we see in Chen et al. (2017). Further, Arin et al. (2019) address model uncertainty using the Bayesian Model Averaging (BMA). Based on OECD countries from 1990-2013, they analyzed how various kinds of government spending in conjunction with an overall budget surplus/deficit affect economic growth. Their remarkable finding of fiscal effects becoming robust with a lag of two years is to be noted. To obtain the medium-term response, we follow their empirical findings by generating every two-year GDP growth rate. They also found that the income tax effect is insignificant, and budget surplus positively impacts growth. However, they did not account for the specific mechanisms by which the disaggregation of usage of fiscal revenues can be directly used as an expenditure that we address in this paper. We believe their choice of diagnosis in budget surplus may mask the effects of public debt, tax, and government expenditure. Therefore, we take an initiative to assess decomposition of fiscal balance to identify which fiscal component(s) will impact growth by following the literature by Chen et al. (2017). While Chen et al. (2017) have comprehensively analyzed the optimal threshold of infrastructure investment and public debt, they accounted less for tax components in their empirical analysis. We took an important step to provide comprehensive reviews of fiscal analysis. Further, the optimal threshold they provided may not properly account for a time-varying threshold that exists under changing circumstances of already high public debt, high inflation rate, and high interest rates; a situation that resonates with current economic conditions. In this paper, we are not trying to assess the optimal threshold, but rather assess the directional growth responses stemming explicitly from the four fiscal components (government consumption, infrastructure investment, tax, and public debt).

Our contribution to the literature can be broadly summarized as follows: we assessed how economic growth may differ by usage of government expenditure (government consumption vs. infrastructure investment) that can arise from fiscal revenues (primarily from either additional tax or additional public debt). To account for model uncertainty that brought the diverse interpretation in literature, we use Bayesian Model Averaging. Further, we analyzed 180 countries from 1990-2019 to address the diverse findings in literature stemming from different country subsets and periods. We found that regardless of revenue sources, government consumption is detrimental to growth. On the contrary, infrastructure investment arising from additional borrowing has a positive relationship with economic growth. This finding is consistent after accounting for the potential bias in interaction terms presented by Cuaresma (2011). Our theoretical analogy that we will discuss in the next section further clarify vital mechanisms to these directions. These analyses are crucial steps towards measuring the sound policy implication for sustainable growth. Addressing the empirical assessment in incorporating the model uncertainty will provide an important role to fill in the missing pieces that will account for a total of 2^k (assuming k being the number of regressors) kinds of model selection for a single simulation.

The rest of the paper is organized as follows. Canonical model summary and equilibrium changes are provided in Section 2 and Section 3. Section 4 describes the data and methodology, and 5 discuss our findings. Section 6 deals with additional sensitivity analysis. Finally, section 7 concludes. The Appendix presents a detailed description of the data and robustness checks.

2 Canonical Model of Fiscal Policy and Balanced Growth

2.1 Fiscal Policy

In this section, we present a small model, the purpose of which is to identify the channels whereby the different fiscal instruments impact the growth rate. The model is adapted from Bruce and Turnovsky (1999), which itself is a modification of the basic Barro (1990) model of endogenous growth.

We consider an economy in which output, Y, is determined according to a simple

Cobb-Douglas technology of the form

$$Y = \alpha G_p^{\beta} K^{1-\beta} \equiv \alpha \left(G_p/K\right)^{\beta} K \qquad 0 \leq \beta \leq 1 \tag{1}$$

where K denotes the private capital stock, assumed to be infinitely durable, and G_p denotes the flow of services from government spending on the economy's infrastructure. Although the firm faces diminishing returns to the accumulation of its private capital stock, the overall technology is linearly homogeneous in the two factors of production taken together. This permits an equilibrium in which the economy follows a path of ongoing endogenous growth.

The economy is populated by an infinitely-lived representative agent who maximizes the intertemporal isoelastic utility function

$$U \equiv \int_0^{\infty} \frac{1}{\gamma} \left(C G_c^{\eta} K^{\theta}\right)^{\gamma} e^{-\rho t} dt \qquad -\infty < \gamma < 1, \eta > 0, \theta > 0, 1 > \gamma(1+\eta+\theta) \tag{2}$$

where C denotes private consumption, G_c denotes the consumption services of a government-provided public good, and the parameter η measures the impact of public consumption on the welfare of the private agent. We assume that both private and public consumption yield positive marginal utility, so that $\eta > 0$. In addition, we assume that the household derives utility from its wealth, K. This term was first introduced into the utility function by Kurz (1968) and subsequently by Zou (1994) and others in their analysis of the "spirit of capitalism". Our reason for doing so is to demonstrate that it is theoretically the only channel whereby government consumption impacts the equilibrium growth rate. The parameter γ is related to the intertemporal elasticity of substitution (IES), s say, by $s = 1/(1-\gamma)$. The remaining constraints on the coefficients appearing in (2) are required to ensure that the utility function remains concave in the quantities C, G_c, K.

At any point in time the household faces the flow budget constraint

$$\dot{K} + \dot{B} = (1-\tau)(rB + Y) - C - T \tag{3}$$

where B denotes the value of government bonds held by the household and r denotes the real rate on government bonds. The government taxes income at the rate τ. We also allow for a lump-sum tax (transfer if negative) denoted by T. This tax plays the role of a "balancing item" in our analysis, and we do not relate it to any existing part of the government tax structure. All the variables, except for the two taxes, are time dependent, although for notational convenience, the time notation is suppressed. Finally, a dot indicates a time derivative.

The household chooses the time path for consumption, and the accumulation of capital and government bonds, so as to maximize its intertemporal utility function, (2), subject to the production function, (1), and its flow budget constraint, (3). In performing this optimization of all government fiscal variables, tax rates as well as expenditure levels, are taken as given.

The agent's optimality conditions can be expressed as

$$C^{\gamma-1}G_c^{\eta\gamma}K^{\theta\gamma} = \lambda \tag{4a}$$

$$r(1-\tau) = \theta\,(C/K) + \alpha(1-\beta)(1-\tau)\,(G_p/K)^{\beta} = \rho - \dot{\lambda}/\lambda \tag{4b}$$

where λ is the marginal utility of wealth. The first condition equates the marginal utility of consumption to the tax-adjusted marginal utility of wealth. The second condition equates the after-tax rate of return on savings, either in the form of bonds or physical capital, to the rate of return on consumption, in accordance with the Keynes-Ramsey consumption rule.[1] In addition, the following transversality conditions must hold

$$\lim_{t\to\infty} \lambda B e^{-\rho t} = \lim_{t\to\infty} \lambda K e^{-\rho t} = 0 \tag{4c}$$

Taking the time derivative of (4a) and combining with (4b), leads to the growth relationship

$$(\gamma-1)\frac{\dot{C}}{C} + \eta\gamma\frac{\dot{G}_c}{G_c} + \theta\gamma\frac{\dot{K}}{K} = \rho - r(1-\tau) \tag{5a}$$

while taking the first equality in (4b) implies that the interest rate is determined by

$$r = \frac{\theta\,(C/K)}{(1-\tau)} + \alpha(1-\beta)\,(G_p/K)^{\beta} \tag{5b}$$

Thus, as the ratio of government infrastructure per unit of capital increases rendering capital more productive, the equilibrium rate of interest must rise. Also, to the extent that capital enhances utility, the interest rate must adjust to reflect that.

[1] Ramsey states the Keynes-Ramsey rule as: "rate of saving multiplied by marginal utility of consumption should always equal bliss minus actual rate of utility enjoyed."

2.2 Balanced Growth

To see the role of the various fiscal instruments, we restrict our attention to fiscal policies that are consistent with a balanced growth equilibrium. Thus, we assume that the income tax rate is constant over time, and that government consumption and infrastructure, though taken as given at any point in time by the household, grow at the same constant rate as output. Specifically, the government is assumed to set its expenditures as constant spending ratios, $G_c = g_c Y$ and $G_p = g_p Y$, where $0 < g_c, g_p < 1$ are constants through time, so

$$\frac{\dot{Y}}{Y} = \frac{\dot{K}}{K} = \frac{\dot{B}}{B} = \frac{\dot{C}}{C} = \frac{\dot{G}_c}{G_c} = \frac{\dot{G}_p}{G_p} \equiv \phi \tag{6}$$

denotes the balanced growth rate at which all real quantities grow. Combining this relationship with (5a) immediately yields the following expression for the equilibrium growth rate

$$\phi = \frac{r(1-\tau) - \rho}{1 - \gamma(1+\eta+\theta)} \tag{7}$$

Also, we can use the aggregate production function to express $G_p/K = (\alpha g_p)^{1/(1-\beta)}$ and substitute in (1) and (5b) to express output and the interest rate in the form

$$\frac{Y}{K} = \left(\alpha g_p^{\beta}\right)^{1/(1-\beta)} \tag{1'}$$

$$r(1-\tau) = \theta\,(C/K) + (1-\beta)(1-\tau)\left(\alpha g_p^{\beta}\right)^{1/(1-\beta)} \tag{5b'}$$

which, with the spending share constant over time, also remains constant. Finally, dividing the economy-wide resource constraint, $Y = C + G_c + G_p + \dot{K}$, by K, we can solve for the constant ratio of consumption to capital, in the form

$$\frac{C}{K} = (1 - g_c - g_p)\left(\alpha g_p^{\beta}\right)^{1/(1-\beta)} - \phi \tag{8}$$

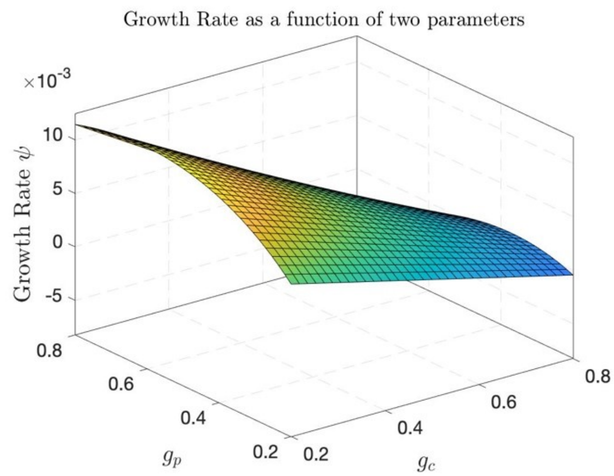
Substituting into (5b'),

$$r(1-\tau) = \theta\left((1-g_c-g_p)\left(\alpha g_p^{\beta}\right)^{1/(1-\beta)} - \phi\right) + (1-\beta)(1-\tau)\left(\alpha g_p^{\beta}\right)^{1/(1-\beta)} \tag{9}$$

and hence equilibrium growth rate is

$$\phi = \frac{\left[\theta\,(1-g_c-g_p) + (1-\beta)(1-\tau)\right]\left(\alpha g_p^{\beta}\right)^{1/(1-\beta)} - \rho}{1 - \gamma(1+\eta+\theta) + \theta} \tag{10}$$

Figure 1: *IRFs* Characterizing the growth rate as a function of g_p & g_c



Note - The remaining parameters were selected following the literature.

3 Equilibrium Changes in the Model

The following conclusions regarding fiscal policy can be drawn immediately. These are partial effects and are based on the assumption that the fiscal shock is financed either by lump-sum taxation or by issuing more debt.

(i) An increase in the income tax rate raises the private consumption ratio and reduces the growth rate.

(ii) If $\theta > 0$, an increase in the government consumption ratio reduces the growth rate. In most endogenous growth models, $\theta = 0$ in which case government consumption has no effect on the growth rate (see Eaton 1981). On the other hand, some growth models introduce elastic labor supply, in which case they find that an increase in government consumption increases the growth rate.

(iii) An increase in the fraction of output spent by the government on infrastructure raises both the real interest rate and the growth rate unless it is too large (Barro 1990).

The model is more general than much of this literature in that we extend the range of fiscal instruments available to the policy maker thus permitting a more general treatment of fiscal issues. This accounts for differences in some of the results from those obtained in the literature. For example, by assuming that, Barro (1990) identifies two offsetting effects of an increase in government infrastructure expenditure on the growth rate. With our more general fiscal specification, these are now decomposed into the two components, the negative income tax effect in (i) and the positive productivity effect in (iii). On the other hand, the invariance of the growth rate with respect to a bond-financed increase in government consumption expenditure is familiar from early work by Eaton (1981).

Before proceeding further with the analysis, two limitations of the model should be noted. First, like Barro (1990), Rebelo (1991), Ireland (1994) we assume that labor is supplied inelastically. This assumption is important in that it implies the neutrality of the consumption tax, noted in (iii) above. An important reason for assuming an inelastic labor supply is to eliminate the static source of supply side effects of tax cuts and focus purely on the dynamic growth effects. Some implications of endogenizing labor supply will be noted in our conclusions. A second assumption of the model is that it assumes complete compliance with the tax code. This ignores the fact that one margin along which agents respond to changes in tax rates is in the resources they devote to tax avoidance activities; see e.g. Cremer and Gahvari (1993), Fullerton and Karayannis (1994). Both of these effects could modify our results and should be kept in mind when considering them.

4 Empirical Methodology

4.1 Methodology (Bayesian Model Averaging)

In this section, we briefly discuss an empirical growth model and Bayesian Model Averaging to illustrate the methodology we follow. The stylized relationship between the usage of government revenues on growth in literature is mixed based on its specifications of government expenditure and assumption of models. The vastly different results in the literature on government expenditure on growth range from a positive relationship to growth (Chen et al. 2017), insignificant or no remarkable responses (Agell et al. 1997), to a negative relationship between the two (Fölster and Henrekson 2001; Bergh and Karlsson 2010; Afonso and Jalles 2014). Primarily, infrastructure investment seems to be a driver of positive contribution to growth (Romero-Avila and Strauch 2008; Furceri and Li 2017). These variety of interpretations are stemming from different focuses on country sets, government expenditure components (i.e., infrastructure investment, government consumption), source of government revenues (i.e., tax or public debt), and lack of model uncertainty incorporation (Fernandez et al. 2001; Barro and Sala-i Martin 2004; Bergh and Karlsson 2010; Arin et al. 2019). Therefore, we incorporate them to have a comprehensive assessment regarding how the usage of government revenue will impact growth.

Rather than generating regressions relying on a single model to test the robustness of findings, we use Bayesian Model Averaging. Our interest is in the unconditional posterior distribution of a parameter vector given data with respect to specific models. Suppose we have j candidate of models M_j where $j \in (1, J)$ with corresponding model parameters, θ_j. For each model of the prior distribution $p(M_j)$, we have a prior distribution for each parameter $p(\theta_j|M_j)$. Then the posterior probability of any one of j models can be expressed as

$$p(M_j|D) = \frac{p(M_j|D)\, p(M_j)}{\sum_{h=1}^{J} p(D|M_h)\, p(M_h)}$$

where $p(D|M_j)$ is the conditional probability generated by the model, which in terms of integrated likelihood is equivalent to $\int p(D|\theta_j, M_j)\, p(\theta_j|M_j)\, d\theta_j$, and $p(M_j)$ is the prior probability of J being the true model. This setup of Bayesian Model Averaging allows the selection of weights to favor good models over weak ones, while results incorporate the essence of data, as each weight was selected based on all possible model and the goodness of fit (or adjusted R^2) performance of each individual model (Raftery 1995; Barro and Sala-i Martin 2004; Bergh and Karlsson 2010; Arin et al. 2019). Further, we average parameter estimates obtained using fixed effect. Among the H possible regressors, there is a set of J $= 2^H$ models M_j where $j \in (1, J)$, for which each is a particular linear combination of growth determinants (see Raftery 1995; Draper 1995; Fernandez et al. 2001; Eicher and García-Peñalosa 2008 for details).

4.2 Our Approaches in Empirical Model Averaging

As an illustration, consider the following equation

$$\Delta_2 y_{i,t} = a + bx + cD + dInt(D, x) + e_{i,t} \tag{11}$$

where x is a continuous variable (i.e., tax and public debt in our model), and D is a dummy variable (i.e., G_p (infrastructure investment to GDP ratio) and G_c (government consumption to GDP ratio) in our model), where dummy is "1" when the two-year growth rate of G_p or G_c is greater than the median of its growth rate, otherwise zero, and Int(.) are interaction between the two terms.

Then, if x increases by one-unit, main effects can be calculated by

$$\begin{cases} d\Delta_2 y_{i,t} = b + c & \text{if } \ D = 1 \\ d\Delta_2 y_t = b & \text{if } \ D = 0 \end{cases}$$

Further, if x increases by one-unit, total effects of an interaction term can be calculated by

$$\begin{cases} d\Delta_2 y_{i,t} = b + c + d & \text{if } \ D = 1 \\ d\Delta_2 y_t = b & \text{if } \ D = 0 \end{cases}$$

The growth rate of country $I = 1, .., N$ in year $t = 0, .., T$ is given by

$$\Delta_2 y_{i,t} = a + bx + cD + dInt(D, x) + \theta' x_{i,t-s} + \nu_{i,t} \quad \text{Where } \ \Delta_2 y_{i,t} = y_{i,t} - y_{i,t-2}$$

We constructed the growth rate in every two years following the recent findings of most fiscal measures identified as robust growth determinants within two years (Arin et al. 2019). The error term consists of: $\nu_{i,t} = \mu_i + \varepsilon_{i,t}$, where μ_i is a country specific effects, and $\varepsilon_{i,t}$ is idiosyncratic errors. $a+bx+cD+dInt(D,x)$ is the key term that we are interested in testing jointly and individually. $x_{i,t-s}$ are control variables, which includes the log of GDP per capita at $t-1$ to control for initial condition. We closely followed the selection of control variables based on the most recent literature Arin et al. (2019) that selected growth determinants following the existing growth literature (Kneller et al. 1999; and Lee and Gordon 2005; Durlauf et al. 2008).

To identify the flow components of infrastructure investment and government consumption overtime, we generated the dummy variable based on the 2-year growth rate of its variable; if the 2-year growth rate is greater than the median of its own, then we have set it as 1, otherwise 0. Then we have interacted it with variables like 2-year lags of government debt to GDP ratio and 2-year lags of tax to GDP ratio. Literature addresses the way to carefully apply interaction terms in Bayesian Model Averaging framework. Masanjala and Papageorgiou (2008) compared growth determinants of Africa vs. the rest of the world by adding dummy and interaction terms in a single generation based on unit information prior (UIP), then found that relevant growth variables for Africa are quite different, supporting the views by Brock and Durlauf (2001). While there should not be statistical problems, Cuaresma (2011) concerns with potential unobservable that the dummy variable may capture and suggest testing BMA without interactions or models with strong heredity prior.

For completeness and transparency, we have addressed this as a sensitivity analysis and carefully diagnosed the results in our interpretation. Our results did not largely change by these additional sensitivity checks.

4.3 Data Description

The analysis mainly uses the International Monetary Fund (IMF) and World Bank (WB) datasets for fiscal variables, growth determinants, and GDP per capita data, covering 180 countries from 1990 to 2019. For the income tax data, we used the data from the Organization for Economic Cooperation and Development (OECD). Other data sources of control variables are primarily obtained by closely following the literature on other growth determinants (Barro 1990; Sala-i Martin 1997; Barro and Sala-i Martin 2004; Arin et al. 2019). Detailed descriptions of the origins of other control variables we used in this analysis are listed in the Appendix of Arin et al. (2019).

5 Baseline Results of Government Borrowings on Growth

As Arin et al. (2019) illustrates, most effects of government expenditure occur with a lag of two years under their analysis of Bayesian Model Averaging, therefore, we looked at growth rate for every two years. Table 1 and Table 2 eliminate all control variables that literature indicates essential to first isolate the effects of our variable of interest. Before moving on to the growth model, testing the individual effects are essential in BMA analysis based on existing results from previous literature (Cuaresma 2011 and Masanjala and Papageorgiou 2008). Further, we address how the joint selection of two instruments viz. G_p, G_c or tax, debt may lead to the total effect on economic growth through the interaction terms in the Bayesian Model Averaging framework.

Looking at individual effects of interaction terms, we see that both debt and income tax are detrimental to growth in general. However, tracing the usage of this additional fiscal spending, when this additional debt is used for infrastructure investment, total effect indicate there is a possible positive impact on growth rate regardless of fiscal revenue sources. On the contrary, if this additional debt is used for government consumption side, the impact is consistently negative on growth. Our data for 180 countries reveal a consistent trend among the different specifications.

Table 1: Joint Effect (Bayesian Model Averaging)

Pooled OLS

Debt X Gp

	Mean	PIP
Gp_dummy	8.94E-04	0.03397242
debt X Gp_dummy	-3.19E-06	0.01856692
lag2_Debt_GDP	5.02E-07	0.01545838
Total effect:	**8.91E-04**	

Tax X Gp

	Mean	PIP
lag2_Tax_GDP	**-0.002764**	**0.6729317**
tax X Gp_dummy	-0.0010418	0.2184748
Gp_dummy	0.00981338	0.1873919
Total effect:	**6.01E-03**	

Debt X Gc

	Mean	PIP
debt X Gc_dummy	-7.17E-05	0.15541131
Gc_dummy	-4.29E-04	0.02828265
lag2_Debt_GDP	-1.83E-06	0.02309064
Total effect:	**-5.02E-04**	

Tax X Gc

	Mean	PIP
lag2_Tax_GDP	**-0.0034753**	**0.80236519**
tax X Gc_dummy	-0.0001264	0.09187128
Gc_dummy	-0.0004409	0.07229917
Total effect:	**-4.04E-03**	

Pooled OLS: w/o interaction

Debt X Gp

	Mean	PIP
Gp_dummy	1.04E-03	0.04562214
lag2_Debt_GDP	-5.22E-08	0.02176037
Total effect:	**1.04E-03**	

Tax X Gp

	Mean	PIP
lag2_Tax_GDP	**-0.0035951**	**0.8524742**
Gp_dummy	0.00245493	0.1440291
Total effect:	**-1.14E-03**	

Debt X Gc

	Mean	PIP
Gc_dummy	-8.56E-04	0.04118831
lag2_Debt_GDP	-4.02E-06	0.03202469
Total effect:	**-8.60E-04**	

Tax X Gc

	Mean	PIP
lag2_Tax_GDP	**-0.003799**	**0.8776336**
Gc_dummy	-0.0009409	0.1167175
Total effect:	**-4.74E-03**	

Note - Dependent variable: every two years of GDP growth rate. To capture the flow components of fiscal expenditure, we generated the dummy variable of infrastructure investment (G_p) and government consumption(G_c) based on the 2-year growth rate; if the growth rate is greater than the median of sample, then we have set it as 1, otherwise 0. Further, to address the long run implication without temporal noise, we calculate the five-year average in sample year before running the regression following the methodology by Arin et al. (2019).

Table 2: Sensitivity Analysis based on Cuaresma (2011) - Joint Effect (Bayesian Model Averaging)

Country Fixed Effect

Debt X Gp

	Mean	PIP
Gp_dummy	**0.08052851**	**1**
debt X Gp_dummy	-0.0002398	0.4223042
lag2_Debt_GDP	0.00014098	0.3634615

Total effect: **8.03E-02**

Tax X Gp

	Mean	PIP
Gp_dummy	**0.14033589**	**1**
tax X Gp_dummy	-0.0104303	0.99993453
lag2_Tax_GDP	0.00014474	0.09629178

Total effect: **1.30E-01**

Debt X Gc

	Mean	PIP
Gc_dummy	**-1.71E-02**	**0.6444767**
debt X Gc_dummy	-5.80E-06	0.03645746
lag2_Debt_GDP	5.38E-07	0.01469132

Total effect: **-1.71E-02**

Tax X Gc

	Mean	PIP
tax X Gc_dummy	1.63E-05	0.01699274
Gc_dummy	8.86E-05	0.01411139
lag2_Tax_GDP	-1.93E-05	0.0125085

Total effect: **1.05E-04**

w/o interaction

Debt X Gp

	Mean	PIP
Gp_dummy	**6.71E-02**	**1**
lag2_Debt_GDP	6.43E-06	0.05899015

Total effect: **6.71E-02**

Tax X Gp

	Mean	PIP
Gp_dummy	**0.05717113**	**0.99999432**
lag2_Tax_GDP	-0.0001647	0.07535043

Total effect: **5.70E-02**

Debt X Gc

	Mean	PIP
Gc_dummy	**-1.97E-02**	**0.74411764**
lag2_Debt_GDP	6.79E-07	0.02731722

Total effect: **-1.97E-02**

Tax X Gc

	Mean	PIP
Gc_dummy	1.40E-04	0.02107061
lag2_Tax_GDP	-2.83E-05	0.01855332

Total effect: **1.12E-04**

Note - Dependent variable: every two years of GDP growth rate. To capture the flow components of fiscal expenditure, we generated the dummy variable of infrastructure investment (G_p) and government consumption(G_c) based on the 2-year growth rate; if the growth rate is greater than the median of sample, then we have set it as 1, otherwise 0. Further, to address the long run implication without temporal noise, we calculate the five-year average in sample year before running the regression following the methodology by Arin et al. (2019).

In the sphere of usage of government tax, we found that effect can be mixed as we observe a possible opposing directional response by an increase in tax spent on government consumption based on incorporation of country fixed effect. Interestingly, we observe a largely similar trend as the case of additional borrowings; if the additional tax were to be used for infrastructure investment, then response on growth is positive, while if it were to be used for government consumption, response can be possibly negative over two years. This illustrates government consumption will generally hurt growth in two years. Robustness can be indicated in bold whenever posterior inclusion probability (PIP) being greater than 0.5. Posterior inclusion probability (PIP) indicates the ranking measure in importance of inclusion of a variable in the regression. Aligning with the approach by Arin et al. (2019), we use a hierarchical binomial beta prior that are found to be less sensitive to prior choice according to Ley and Steel (2009). Our findings are largely consistent to Arin et al. (2019), while our results are generally more robust by including over 150 additional countries. Furthermore, to expand our horizon beyond the scope of their findings, we have assessed the usage of fiscal revenues on growth using interaction terms in the subsequent sections.

Once we analyzed how the interaction terms indicate the possible relationship between the usage of government revenues on economic growth rate, in Table 3 and Table 4, we incorporated them into the framework of economic growth model that is widely used in the literature on growth determinants (Barro 1990; Barro and Sala-i Martin 2004; Arin et al. 2019). We closely followed the selection of control variables listed by Arin et al. (2019). Aligning with our findings in Table 1 and Table 2, we found that increase in infrastructure investment is strictly positively impact on growth regardless of fiscal sources. Once we accounted the country fixed effect, this response becomes robust. This finding is persistent when we assess the sensitivity analysis introduced by Cuaresma (2011). We incorporated both OLS and fixed effect results because if there is correlation between unobservable country characteristics and control variables, then coefficients of the variable of interest will be biased unless the model properly controls for the country characteristics. On the contrary, fixed-effects approach also eliminates all cross-country variation and some of this variation may contain valuable information about the relationship between the growth rate and our variable of interests. We therefore explore both of these approaches for transparency and comprehensiveness in line with the existing literature.

Interestingly, we observe a mild negative association between the years of education and growth rate. Barro (2001) illustrates the insignificant relationship between growth rate and the years of school attainment of females at the secondary and higher levels. This

Table 3: Fiscal Revenue to Infrastructure Investment (OLS: Growth Model on Bayesian Model Averaging)

Pooled OLS

Debt X Gp

	Mean	PIP
laglny1	**-1.25E-02**	**0.60467462**
lag_Lifeexp	8.30E+00	0.42467542
lag_TFR	-5.48E-03	0.24218901
lag_Corruption	-2.78E-03	0.17910066
Gp_dummy	7.16E-03	0.15190674
lag_Inflation	2.52E-04	0.13597056
lag_Trade	3.78E-05	0.13390534
lag_Yrschool	-1.51E-05	0.03511894
lag_population	1.12E-12	0.02869985
debt X Gp_dummy	-4.19E-06	0.02390315
lag2_Debt_GDP	-3.29E-06	0.02289766
Total effect:	**7.15E-03**	

Tax X Gp

	Mean	PIP
lag_Lifeexp	**5.78E+01**	**0.92618377**
lag_Trade	3.61E-05	0.1299829
laglny1	-3.55E-03	0.10990672
lag_Corruption	-7.83E-04	0.08186637
lag2_Tax_GDP	-1.90E-04	0.07944192
lag_Inflation	-1.10E-04	0.0752698
lag_population	-7.99E-12	0.0499653
Gp_dummy	1.40E-03	0.04448608
tax X Gp_dummy	-7.07E-05	0.03551023
lag_Yrschool	-1.15E-05	0.0302227
lag_TFR	-3.00E-04	0.02617914
Total effect:	**1.14E-03**	

Pooled OLS: w/o interaction

Debt X Gp

	Mean	PIP
laglny1	**-1.25E-02**	**0.60585792**
lag_Lifeexp	8.94E+00	0.45226923
lag_TFR	-6.37E-03	0.27917969
lag_Corruption	-2.88E-03	0.19041866
Gp_dummy	7.60E-03	0.16802701
lag_Trade	4.42E-05	0.1559567
lag_Inflation	2.73E-04	0.14953983
lag_Yrschool	-1.72E-05	0.04066233
lag_population	1.30E-12	0.03382209
lag2_Debt_GDP	-3.78E-06	0.0265651
Total effect:	**7.59E-03**	

Tax X Gp

	Mean	PIP
lag_Lifeexp	**5.76E+01**	**0.92336473**
lag_Trade	3.98E-05	0.1433578
laglny1	-3.77E-03	0.11820669
lag_Corruption	-8.81E-04	0.09201122
lag2_Tax_GDP	-2.13E-04	0.08935106
lag_Inflation	-1.23E-04	0.08396768
lag_population	-8.88E-12	0.05582195
Gp_dummy	1.10E-03	0.04383789
lag_Yrschool	-1.35E-05	0.03472384
lag_TFR	-3.34E-04	0.02951718
Total effect:	**8.83E-04**	

Note - Dependent variable: every two years of GDP growth rate. To capture the flow components of fiscal expenditure, we generated the dummy variable of infrastructure investment (G_p) and government consumption(G_c) based on the 2-year growth rate; if the growth rate is greater than the median of sample, then we have set it as 1, otherwise 0. Further, to address the long run implication without temporal noise, we calculate the five-year average in sample year before running the regression following the methodology by Arin et al. (2019).

Table 4: Fiscal Revenue to Infrastructure Investment (Fixed Effect: Growth Model on Bayesian Model Averaging)

Country Fixed Effect

Debt X Gp

	Mean	PIP
lag_Lifeexp	**7.46E+01**	**1**
lag_TFR	**-7.30E-02**	**1**
Gp_dummy	**9.85E-02**	**1**
lag_Corruption	**-3.22E-02**	**0.99999988**
lag_Trade	**1.09E-03**	**0.99999972**
lag_Yrschool	**-1.98E-03**	**0.9999997**
debt X Gp_dummy	**-5.72E-04**	**0.92852215**
laglny1	**-2.48E-02**	**0.91195823**
lag_population	**4.38E-10**	**0.89302631**
lag2_Debt_GDP	-2.15E-05	0.14117426
lag_Inflation	9.73E-07	0.09831248

Total effect: **9.79E-02**

w/o interaction

Debt X Gp

	Mean	PIP
lag_Lifeexp	**7.56E+01**	**1**
Gp_dummy	**6.82E-02**	**1**
lag_TFR	**-7.60E-02**	**1**
lag_Corruption	**-3.30E-02**	**0.9999999**
lag_Yrschool	**-2.00E-03**	**0.9999998**
lag_Trade	**1.10E-03**	**0.9999996**
laglny1	**-2.30E-02**	**0.8695442**
lag_population	**3.99E-10**	**0.8536138**
lag2_Debt_GDP	**-2.62E-04**	**0.7376265**
lag_Inflation	1.04E-05	0.1418442

Total effect: **6.79E-02**

Tax X Gp

	Mean	PIP
Gp_dummy	**1.51E-01**	**1**
lag_Corruption	**-3.37E-02**	**1**
lag_Lifeexp	**1.12E+02**	**0.99999986**
tax X Gp_dummy	**-1.02E-02**	**0.99997421**
lag_TFR	**-9.26E-02**	**0.99901451**
lag2_Tax_GDP	**-7.83E-03**	**0.84098896**
lag_Yrschool	**-7.55E-04**	**0.76680809**
lag_Trade	2.02E-04	0.46211445
laglny1	-8.01E-03	0.31047463
lag_Inflation	-4.95E-05	0.11491954
lag_population	3.20E-11	0.09677815

Total effect: **1.33E-01**

Tax X Gp

	Mean	PIP
Gp_dummy	**7.05E-02**	**1**
lag_Corruption	**-3.36E-02**	**1**
lag_Lifeexp	**1.21E+02**	**0.99999999**
lag_TFR	**-9.14E-02**	**0.99972651**
lag2_Tax_GDP	**-1.29E-02**	**0.9976022**
lag_Yrschool	-3.81E-04	0.45996151
lag_Trade	1.78E-04	0.40460654
laglny1	-5.46E-03	0.22614341
lag_Inflation	-5.57E-05	0.10377459
lag_population	5.96E-12	0.06636804

Total effect: **5.77E-02**

Note - Dependent variable: every two years of GDP growth rate. To capture the flow components of fiscal expenditure, we generated the dummy variable of infrastructure investment (G_p) and government consumption(G_c) based on the 2-year growth rate; if the growth rate is greater than the median of sample, then we have set it as 1, otherwise 0. Further, to address the long run implication without temporal noise, we calculate the five-year average in sample year before running the regression following the methodology by Arin et al. (2019).

may contribute to our results of near zero responses by an increase in years of education. Further, the total fertility rate and higher corruption index are signaled negatively affecting the growth rate aligning with literature (Mauro 1995; Barro 1991; Barro and Becker 1989).

On the aspect of the usage of government revenue on government consumption in Table 5 and Table 6, we also found a remarkable consistent trend following the Table 1 and Table 2 in terms of both public debt and income tax. If additional borrowings/income were to be spent on government consumption, then it will directly hurt growth. This result is consistent to our theoretical findings in the section 2 and 3. These findings are remarkable in terms of policy perspectives. Our findings largely align to the existing literature on this same issue (Cameron 1982; Landau 1986; Hansson and Henrekson 1994; Arin et al. 2019).

Besides fiscal components, reciprocal life expectancy is significantly associated with economic growth. Once a country fixed effect is incorporated, this trend becomes more robust persistently. These findings can also be confirmed in Arin et al. (2019). Robust results in various fiscal components may indicate that changes in fiscal expenditure generally have a sound effect on economic growth, strengthening the policy implication.

These findings highlight the importance of focusing on infrastructure investment for future economic development. Further, a generally greater magnitude of posterior mean in our results indicates that additional government borrowing spending on government consumption tends to hurt the economic growth rate more than the increase in government consumption financed by the income tax rate. However, we need to note that this does not necessarily imply that higher income tax is always recommended; theoretically speaking, an extreme rise in income tax will raise the private consumption ratio, directly negating economic growth. An excessive income tax increase is not expected to be desirable for economic growth.

Based on our empirical findings, one may conclude that more infrastructure is always better for economic growth. As discussed in sections 2 and 3, we claim that since countries so far have not yet reached the threshold level of infrastructure investment to GDP ratio, concerning our baseline results, more infrastructure is expected to bring higher economic growth returns in this state of the economy. Excessive infrastructure investment may be detrimental to economic growth, as it will lead to a crowding-out effect, and balancing it with government consumption expenditure is recommended.

Table 5: Fiscal Revenue to Government Consumption (OLS: Growth Model on Bayesian Model Averaging)

Pooled OLS

Debt X Gc

	Mean	PIP
laglny1	**-1.06E-02**	**0.5574394**
lag_Corruption	-7.49E-03	0.40771023
lag_TFR	-5.08E-03	0.23007566
lag_Lifeexp	3.80E+00	0.21100448
lag_Trade	1.21E-05	0.05582819
lag_Inflation	7.76E-05	0.05412905
Gc_dummy	-1.69E-03	0.0503727
debt X Gc_dummy	-8.79E-06	0.02710534
lag_Yrschool	-8.18E-06	0.02638928
lag_population	9.66E-13	0.02390169
lag2_Debt_GDP	-2.28E-06	0.0174595

Total effect: **-1.70E-03**

Tax X Gc

	Mean	PIP
lag_Lifeexp	**6.01E+01**	**0.93952624**
lag_Trade	3.53E-05	0.12901109
lag_Corruption	-1.07E-03	0.10453628
laglny1	-3.10E-03	0.09746518
lag_Inflation	-1.42E-04	0.09176984
lag2_Tax_GDP	-1.80E-04	0.07649151
lag_population	-7.84E-12	0.04941996
tax X Gc_dummy	-5.46E-05	0.03193893
lag_TFR	-3.87E-04	0.02911928
lag_Yrschool	-1.05E-05	0.02895372
Gc_dummy	-3.24E-06	0.01958487

Total effect: **-2.38E-04**

Pooled OLS

Debt X Gc

	Mean	PIP
laglny1	**-1.06E-02**	**0.55718769**
lag_Corruption	-7.49E-03	0.41357948
lag_TFR	-5.92E-03	0.26411101
lag_Lifeexp	4.37E+00	0.2403437
lag_Trade	1.40E-05	0.06472569
lag_Inflation	8.54E-05	0.06049619
Gc_dummy	-2.01E-03	0.0597477
lag_Yrschool	-9.74E-06	0.03042626
lag_population	1.09E-12	0.02748353
lag2_Debt_GDP	-2.60E-06	0.02029294

Total effect: **-2.01E-03**

Tax X Gc

	Mean	PIP
lag_Lifeexp	**5.99E+01**	**0.93763112**
lag_Trade	3.89E-05	0.14242251
lag_Corruption	-1.19E-03	0.11686202
laglny1	-3.28E-03	0.10493405
lag_Inflation	-1.57E-04	0.10224833
lag2_Tax_GDP	-2.02E-04	0.08602854
lag_population	-8.78E-12	0.0555963
lag_Yrschool	-1.22E-05	0.0333124
lag_TFR	-4.30E-04	0.03283563
Gc_dummy	-2.96E-05	0.02202349

Total effect: **-2.31E-04**

Note - Dependent variable: every two years of GDP growth rate. To capture the flow components of fiscal expenditure, we generated the dummy variable of infrastructure investment (G_p) and government consumption(G_c) based on the 2-year growth rate; if the growth rate is greater than the median of sample, then we have set it as 1, otherwise 0. Further, to address the long run implication without temporal noise, we calculate the five-year average in sample year before running the regression following the methodology by Arin et al. (2019).

Table 6: Fiscal Revenue to Government Consumption (Fixed Effect: Growth Model on Bayesian Model Averaging)

Country Fixed Effect

Debt X Gc

	Mean	PIP
lag_Lifeexp	**7.68E+01**	**1**
lag_Yrschool	**-2.46E-03**	**1**
lag_Corruption	**-3.34E-02**	**0.99999999**
lag_TFR	**-6.95E-02**	**0.99999998**
lag_Trade	**1.13E-03**	**0.99999997**
Gc_dummy	**-4.84E-02**	**0.99700142**
lag_population	**2.41E-10**	**0.56652521**
lag2_Debt_GDP	-1.40E-04	0.43236803
laglny1	-1.61E-03	0.12881101
debt X Gc_dummy	1.93E-05	0.0844005
lag_Inflation	6.40E-06	0.05053828

Total effect: **-4.85E-02**

Tax X Gc

	Mean	PIP
lag_Lifeexp	**1.11E+02**	**1**
lag_Corruption	**-3.54E-02**	**1**
lag_TFR	**-7.12E-02**	**0.95925989**
lag2_Tax_GDP	**-8.67E-03**	**0.87252351**
lag_Yrschool	-4.56E-04	0.46956178
lag_Trade	3.26E-05	0.09900949
Gc_dummy	-5.09E-04	0.05117568
tax X Gc_dummy	-4.47E-05	0.0467116
lag_Inflation	-1.61E-05	0.03853033
lag_population	-1.91E-11	0.03848836
laglny1	-3.63E-05	0.02960706

Total effect: **-9.23E-03**

Country Fixed Effect

Debt X Gc

	Mean	PIP
lag_Lifeexp	**7.66E+01**	**1**
lag_Yrschool	**-2.45E-03**	**1**
lag_Corruption	**-3.37E-02**	**0.99999999**
lag_TFR	**-6.88E-02**	**0.99999998**
lag_Trade	**1.13E-03**	**0.99999998**
Gc_dummy	**-4.77E-02**	**0.99998426**
lag_population	**2.78E-10**	**0.64665413**
lag2_Debt_GDP	**-1.58E-04**	**0.50573695**
laglny1	-2.43E-03	0.18782101
lag_Inflation	9.19E-06	0.07621187

Total effect: **-4.78E-02**

Tax X Gc

	Mean	PIP
lag_Lifeexp	**1.11E+02**	**1**
lag_Corruption	**-3.53E-02**	**1**
lag_TFR	**-7.29E-02**	**0.96836828**
lag2_Tax_GDP	**-8.85E-03**	**0.89076011**
lag_Yrschool	**-4.93E-04**	**0.50895112**
lag_Trade	3.96E-05	0.11949151
Gc_dummy	-6.65E-04	0.06495431
lag_population	-2.34E-11	0.04695025
lag_Inflation	-1.86E-05	0.04607432
laglny1	-4.57E-05	0.03602974

Total effect: **-9.52E-03**

Note - Dependent variable: every two years of GDP growth rate. To capture the flow components of fiscal expenditure, we generated the dummy variable of infrastructure investment (G_p) and government consumption(G_c) based on the 2-year growth rate; if the growth rate is greater than the median of sample, then we have set it as 1, otherwise 0. Further, to address the long run implication without temporal noise, we calculate the five-year average in sample year before running the regression following the methodology by Arin et al. (2019).

6 Sensitivity Analysis

Cuaresma (2011) brings concerns of using interaction terms within the Bayesian Model Averaging framework. Even though statistically speaking, the approach does not have an issue, there could be a potential unobservable that the dummy variable may capture. They suggest testing BMA without interactions or models with a strong heredity prior. Therefore, we eliminated the interaction term to see if there is a difference in growth implications. We found that exclusion of the interaction term did not change as in Table 7.

Table 7: Further Sensitivity Analysis based on Cuaresma (2011)

Pooled OLS w/o all interests

	Mean	PIP
laglny1	**-1.43E-02**	**0.6984252**
lag_TFR	-9.29E-03	0.410844
lag_Corruption	-5.55E-03	0.3343172
lag_Lifeexp	5.48E+00	0.30692934
lag_Trade	2.83E-05	0.12233817
lag_Inflation	6.63E-05	0.06522087
lag_Yrschool	-1.57E-05	0.04529272
lag_population	1.28E-12	0.03723678

Country Fixed Effect w/o all interests

	Mean	PIP
lag_Lifeexp	**7.09E+01**	**1**
lag_TFR	**-6.92E-02**	**1**
lag_Trade	**1.16E-03**	**1**
lag_Corruption	**-3.39E-02**	**0.99999999**
lag_Yrschool	**-2.15E-03**	**0.99999999**
lag_population	**2.68E-10**	**0.64220369**
laglny1	**-1.29E-02**	**0.63057435**
lag_Inflation	-5.30E-06	0.09789323

Note - Dependent variable: every two years of GDP growth rate. To capture the flow components of fiscal expenditure, we generated the dummy variable of infrastructure investment (G_p) and government consumption(G_c) based on the 2-year growth rate; if the growth rate is greater than the median of sample, then we have set it as 1, otherwise 0. Further, to address the long run implication without temporal noise, we calculate the five-year average in sample year before running the regression following the methodology by Arin et al. (2019).

7 Conclusion

We analyze the mechanisms of how the usage of government expenditures impact on economic growth. The existing literature so far on this field was puzzling because of different focus of country sets, the lack in addressing the model uncertainty and the insufficient assessment in the decomposition of government revenue/expenditure, which may have been the reason for the mixed findings in the previous literature. We address this issue by first building the endogenous growth model based on Bruce and Turnovsky (1999), which is a modification of the basic Barro (1990) model of endogenous growth. To assess the empirical nuances with sensibly addressing the diverse findings in literature, we use comprehensive 180 countries data, and accounted for model uncertainty by applying the Bayesian Model Averaging. IMF, World Bank, and OECD databases enable us to assess based on primal four compositions of fiscal expenditures. Namely, how economic growth may differ by government expenditure (government consumption vs. infrastructure investment) that can arise from fiscal revenues primarily from either additional tax or additional public debt.

Our results indicate that increase in debt and income tax are persistently detrimental to growth. This confirms debt overhang hypothesis (Myers 1977) that claim having additional debt may hurt the country rather than benefit as it potentially increase default risk. We also confirm that if the government use this additional fiscal revenue for increase in infrastructure investment, it will positively impact on growth regardless of fiscal revenues of taxes or debt (additional borrowings). A negative response arises from them being used to increasing government consumption. This mechanism was also supported by our theoretical model. These effects we observed in the Bayesian Model Averaging were consistent after we address the possible bias introduced by Cuaresma (2011). Our findings reveal that when governments face a trade-off in supporting current consumption or boosting infrastructure investment, as policy implication they are encouraged to spend more for the latter since it is forecasted to provide robust increases in economic growth. In theory, if there is an increase in infrastructure investment for efficient transportation, this will provide more convenient and instant labor mobility and easy market accessibility to the society that will enable the higher productivity.

Our findings on the importance of focusing on infrastructure investment for future economic growth do not necessarily mean that the higher the infrastructure investment, the better. Since countries so far have not yet reached the threshold level of infrastructure investment to GDP ratio concerning our baseline results, more infrastructure is expected to bring higher economic growth returns in this state of the economy. Excessive infrastructure investment may be detrimental to economic growth, and we need to note that balancing it with government consumption expenditure is recommended.

We acknowledge that while our findings are largely aligning with our theoretical grounds, precise magnitude of how much growth rate is feasible is still not concrete in this literature. This step is challenging to address under changing economic circumstances of recent years surge in public debt, high inflation rate, and high-interest rates; a situation that resonates in our recent macroeconomic trend. As a future assessment on this topic could also improve by more distinct fiscal spending data (corporate tax, income tax, consumption tax, property tax, etc).

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