VŠE / FACULTY OF INTERNATIONAL RELATIONS

Working Paper Series

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Working Paper 2020 - 01

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ISSN 2695-0820

Reassessment of the Fiscal Multiplier in Developing Countries: Regime-Switching Model

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October 21, 2020

Abstract

The existing literature on fiscal policy has mainly employed linear models that found a small fiscal multiplier in developing economies. These findings challenge the importance and effectiveness of fiscal policy for these countries. However, linear models are not capable of distinguishing the size of the fiscal multiplier in different phases of economic cycles. Responding to the previous studies that confirm regime dependency of a fiscal multiplier, our model enriches the literature of regime-switching models using a non-linear panel threshold vector autoregression (PTVAR) model to measure the size of the fiscal multiplier for developing countries. Our finding confirms asymmetry in the response of GDP with regard to the economic situation. The main result of our paper shows that the response of GDP to government expenditure shock during a recovery period for developing countries is double that for developed ones. Our results also confirm a significantly larger fiscal multiplier during recovery compared to the economic downturn.

Keywords: Fiscal multiplier, developing countries, regime-switching, the panel threshold vector autoregression model.

JEL Codes: E32; E62; G15; C54.

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1 Introduction

Fiscal policy is the focus of a remarkable number of macroeconomic studies and can be described as a government's key tool related to taxes, investment, expenditure, and the reallocation of resources in public and private sectors. The effectiveness of fiscal policy is measured by the fiscal multiplier, which is the ratio of changes in output to changes in government expenditure. Despite its central role in macroeconomic policy and the rich economic literature devoted to its study, consensus on the effect of fiscal policy on output has still not been reached. Recent studies confirm that fiscal policy performs non-linear patterns depending on the phases of the business cycle (e.g., Arin et al., 2015). However, the empirical research conducted on fiscal policy with multi-regime models covers mainly developed countries (e.g., Auerbach and Gorodnichenko, 2012; Mittnik and Semmler, 2012; Ko and Morita, 2013; Rafiq, 2014; Caggiano et al., 2015; Afonso et al., 2018). To the best of our knowledge, our work is the first study to investigate fiscal policy under the regime-switching model for developing economies.

There is substantial disagreement regarding the real effect of a fiscal policy on economic activity. The disagreements relate to the choices of different model, economic phases (expansion vs. recession), and specific country samples (e.g., Blanchard and Perotti, 2002; Auerbach and Gorodnichenko, 2012; Ilzetzki et al., 2013; Kourtellos et al., 2016; Auerbach et al., 2019). The mutual relationship between government expenses and output changes raises concerns in empirical work and impedes the determination of the direct effect of government expansion on output (e.g., Auerbach and Gorodnichenko, 2013). There are different approaches in estimating the impact of government intervention on economic output, but the two most common approaches employ the structural vector autoregressions (SVARs) or linearized dynamic stochastic general equilibrium (DSGE) models, which by their construction cannot account for non-linear patterns. Our model enriches the literature of regime-switching models using a non-linear panel threshold vector autoregression (PTVAR) model to measure the size of the fiscal multiplier for developing countries.

The size of the fiscal multiplier is more important during a period of recession than economic expansion, because of the role of fiscal policy in the stabilization of the economy and promoting a high pace of economic development (e.g., Auerbach and Gorodnichenko, 2013). Studies emphasize that the importance and content of fiscal policy are different in the different

phases of the business cycle (e.g., Arin et al., 2015). Differences in the size of the fiscal multiplier over economic periods require the use of regime-switching models to better estimate the magnitude of the fiscal multiplier. Response of economic outcome is expected to be substantially larger if government intervention occurs during a recession than during an expansion; therefore it is pivotal to distinguish between multipliers in economic downturns and expansion.

Studies comparing the effectiveness of fiscal policy across advanced and developing countries mainly employ linear models and claim that the fiscal multiplier is larger in the former group of countries (e.g., Ilzetzki and Vegh, 2008; Kraay, 2012; Ilzetzki et al., 2013). The difference in size of the fiscal multiplier for developed and developing countries might be a result of systematic disparity in the structure of GDP, labor market mechanisms, availability and source of financial resources, smoothness of consumption behavior, as well as efficiency of public administration and management (Batini et al., 2014).

Our paper contributes to the empirical literature by conducting a comprehensive investigation of the fiscal multiplier size in both developing and developed economies using the regime-switching model. We address the behavior and magnitude of output response to government intervention during recession and expansion phases. The most important finding of our research is an asymmetry in the response of GDP to government expenditure shock with regard to the economic situation. In contrast to most of the literature, we found the size of the impulse response is larger for developing countries during the economic recovery and similar to developed ones in the state of economic downturn. Our result does not stand in line with most of the studies that have found smaller effect in developing countries compared to developed ones. The reasons behind larger fiscal multipliers in developing countries might relate to less prevalent consumption smoothing behavior due to financial liquidity constraints, small automatic stabilizers, and relatively low public debt levels. When the economy is switching from the period of "downturn" to "recovery", precautionary saving behavior yields to optimistic and aggressive investment. Then, the average return is higher in developing countries, which leads to a larger fiscal multiplier.

The rest of the paper proceeds as follow. Section 2 reviews literature. Data samples are provided in Section 3. Our model identification is explained in Section 4. Section 5 presents and discusses the model estimations, while Section 6 concludes.

2 Literature review

Theoretical discrepancies in the literature on the size and the impact of the fiscal multiplier partially arise from the fact that different schools of economic thought emphasize different channels to explain this process. While the New Keynesian approach argues that fiscal policy can stimulate aggregate demand and eliminate the recessionary gap, the New classical macroeconomic perspective argues that a marginal increase in a household's wealth level would have a limited impact on current consumption. According to the New classical school, the Ricardian equivalence that fiscal shock will not have a real impact on the recessionary gap as a result of the inter-generational altruistic transfer system holds in the long run, as households will increase their savings to match the present discounted values of future taxes and expenditures, avoiding passing the effect on the following.

Macroeconomic models, particularly DSGE models, are commonly used for simulating the impact of fiscal policy on economic outcomes (e.g., Woodford, 2011; Eggertsson, 2011; Babecký et al., 2018). The main advantage of DSGE models over VAR models is that they capture the behavior of the economy as a whole by analyzing the interaction and combination of many microeconomic decisions. However, estimating fiscal multipliers using DSGE models has its own challenges as there is a little consensus on fiscal policy modeling, and also as these models are based on linearized equations, which leads to rule out state-dependent multipliers. Babecký et al. (2018) suggested that the fiscal multiplier would be systematically underestimated using DSGE models. The authors implemented 'modified' Bayesian techniques, with the priors that formulated by solving macroeconomic model compared to pure Bayesian VAR models, where priors were based on time series or statistical criteria. The results suggest that using the hybrid DSGE-VAR model for the Czech economy covering the period from 1996 to 2011 at quarterly frequency lead to fiscal multipliers two times larger than those from the DSGE counterpart.

There are different approaches in estimating the impact of government intervention on economic output using VAR models. The main issue in the empirical methodology is related to the two-way relationship between government actions and output change: government spending could affect output, but output could also impact government spending (Batini et al., 2014). This leads to difficulty in distinguishing the direct effect of government expansion on economic output. We need to define the effects of exogenous shocks in government expenses while we

estimate the size of the fiscal multiplier. To deal with the identification problem five main methods are employed to estimate government intervention: The recursive approach introduced by Sims (1980), and applied by Fatás and Mihov (2001); the event-study approach introduced by Ramey and Shapiro (1998); the structural VAR approach proposed by Blanchard and Perotti (2002), and extended in Perotti (2005); the sign-restrictions approach developed by Uhlig (2005), and "the narrative approach" introduced by Romer and Romer (2010). Although empirical studies coincide in many dimensions, there is still no commonly agreed methodology and little consensus on the size of fiscal multipliers. We follow the seminal paper by Blanchard and Perotti (2002), who propose a structural autoregression model method (SVAR) that uses following identifying assumptions to extract structural shocks and their relationship with GDP. Authors claim that the response of the government expenditure to GDP is more sluggish, therefore high-frequency data (i.e., quarterly) and the assumption of the contemporaneous response of government spending to GDP is zero might alleviate the endogeneity problem.

SVAR models are subject to some shortcomings. The structural identification approach may fail to capture purely exogenous fiscal shocks (Batini et al., 2014). To address this issue, studies have developed a "narrative method" that generates purely exogenous fiscal shocks by using information independent of the state of the economy (e.g. Romer and Romer, 2010; Ramey, 2011; Guajardo et al., 2014). The "narrative method" presents some practical challenges since the quantification of measures may be based on incorrect macro assumptions (Batini et al., 2014). Moreover, VAR models (as well as SVARs) provide an estimate of the average response of output to exogenous fiscal shocks based on past information. This raises a concern that if a sample country experienced crucial structural changes during past periods, the "average" multiplier will not be able to capture the real effect of fiscal policy on current output. A few studies have addressed this issue by employing non-linear SVARs to examine whether multipliers vary across the different economic phases (Baum et al., 2012; Auerbach and Gorodnichenko, 2013). Using the panel threshold vector autoregression (PTVAR) model, we consider the fact that movements in the fiscal multipliers can result in different economic outcomes and consequently, these responses may correspond to different regimes, depending on whether the economy is in recession or recovery.

The number of studies addressing the fiscal multiplier in developing countries is limited,

and conclude that the size of the multiplier for developing countries is smaller than for developed ones (Ilzetzki and Vegh, 2008; Kraay, 2012; Ilzetzki et al., 2013; Estevo and Samak, 2013; Hory, 2016). The fiscal multiplier is the ratio of changes in output to changes in government expenditure. If a given multiplier is greater than one, it means that the economy earns more than one per each unit of currency spent by the government; however, if less than one, then it means the growth of GDP was less than the resources spent by the government. Ilzetzki and Vegh (2008) found that cumulative fiscal multipliers reach their peak at 0.63 for developing countries and 0.91 for developed countries. Kraay (2012) confirms a lower fiscal multiplier in developing economies, using the database of World Bank loans. While the long-run multiplier is close to one for advanced economies, it is significantly lower for developing countries because of the strong crowding out effect. The differences in fiscal multipliers between developing and advanced countries might be the result of systematic divergence in several fundamental economic factors including the structure of GDP, labor market characteristics, availability and source of financial resources, smoothness of financial transmission channels, and fluctuations in the exchange rate of the domestic currency, as well as some conjectural factors like efficiency of public administration and management.

The reason behind the findings on insignificant fiscal multiplier in developing countries might relate to the linear nature of both the vector autoregression (VAR) and log-linearized DSGE models employed in the literature. The linear models do not reconcile with the fact that fiscal policy may change its goal, content, and means when being applied in a time of economic downturn or recovery. According to Mittnik and Semmler (2012), existing studies seem to imply that the particular state of the economy when the government intervention takes place has a direct effect on the consequences of government policy, but linear models are not capable of capturing state dependency. Technically, the impulse response functions of approximated time series in linear models do not depend on the current regime, and they are symmetric with respect to the sign and the size of a shock. The main aim of our paper is to address this issue by implementing a model that fits the content of fiscal policy in developing economies.

We estimate a fiscal multiplier for developing countries, and in order to implement this task, we use the panel threshold vector autoregression (PTVAR) model. A further attractive feature of the multi-variable threshold model is its relative simplicity among the non-linear

models; it can be thought of as a combination of piecewise linear modes with different coefficients for different periods (Tsay, 1998). Moreover, the threshold that defines the different regimes can be linked to the endogenous variables of the model by choosing the lag of the variable of interest. Such a specification enables a regime change to react to any shock in the economy (Afonso et al., 2018). A common outcome of the studies investigating fiscal policy with regime-switching models is that they generally find a higher impact during periods of crisis. For example, Bachmann and Sims (2012) and Auerbach and Gorodnichenko (2013) find higher fiscal multipliers in periods of recession. Thus, choosing a PTVAR model in our investigation helps to distinguish the relative difference between fiscal effects in expansionary and recessionary periods in developing countries.

3 Data Sample

The identification assumption of the model imposes a restriction on the frequency of data. To be consistent with the main assumption that underlying the identification strategy, the frequency of observation should be increased as much as possible. In particular, quarterly data better fits the identification strategy. The papers by Blanchard and Perotti (2002) and Ilzetzki et al. (2013) used a quarterly data set. However, some papers still use longer frequencies, for instance, semiannual (Auerbach and Gorodnichenko, 2012) or annual (Estevo and Samak, 2013; Auerbach et al., 2019) data from OECD countries.

Our sample period covers 1995Q1-2015Q4, taken from the IMF database [1] in national currency, nominal, and non-seasonally adjusted terms. We use quarterly data of GDP, government consumption expenditure, and tax revenues. This database is one of the most frequently used and comprehensive sources, covering a high range of countries with the required frequency. Moreover, as the majority of papers involved in fiscal policy investigations used the same data, this will facilitate comparisons. Average GDP growth rates in developing countries are higher than those in developed ones (see Figure A1 in the Appendix).

The discrepancies observed in outcomes can be explained by the result of different methodologies, rather than differences stemming from the dataset. By using the Consumer Price Index (CPI) and the exchange rate of the same source, and through straightforward ma-

[1] Data are downloaded from the International Financial Statistics (IFS) and Government Finance Statistics (GFS) by the IMF.

nipulations, we obtain series in smoothed and real terms. In the estimation all variables are transformed into log-difference forms. Countries are divided into two subgroups: developed and developing, based on the classification of the UN's World Economic Situation and Prospects 2014 report. Our sample contains 34 countries, which are equally divided into two subcategories, resulting in 17 countries for each group (see Table-A1 in the Appendix).

4 Model Identification

The literature suggests two approaches to implementing the regime-switching VAR analysis. The first approach advises using a country-by-country threshold VAR model (e.g., Baum et al., 2012) and obtain estimates separately. The second approach proposes pooling all countries and regressing a panel dynamic regime-switching model (e.g., Auerbach and Gorodnichenko, 2012). Our model closely follows the second approach, which is a hybrid of the Panel VAR model with the threshold autoregressive model.

Panel VARs have been widely used in the empirical analysis to study the similarities and convergences among groups of countries, and the patterns of transmission shocks across time and regions (Canova and Ciccarelli, 2013). The effect of government intervention may vary depending on certain conditions. If the response of output endogenously depends on certain conditions, the linear model will produce misleading results. Therefore, a regime dependent model must be employed to obtain consistent estimates. Following the seminal paper by Blanchard and Perotti (2002), the PTVAR model is in the following form:

$$X_{it} = \alpha_1 + \beta_1 X_{i,t-1} + (\alpha_2 + \beta_2 X_{i,t-1}) I(q_{i,t-1} < \gamma) + u_{it} \tag{1}$$

where "i" and "t" indicate country and time. X_{it} is a matrix of log real government purchases $[G_{it}]$, log real taxes $[T_{it}]$, and log real GDP $[Y_{it}]$. I[*] is an indication function, q_{it} is a threshold variable, and γ is a threshold value. If q_{it} is less than γ, I[*] is equal to zero, and one otherwise. If the economy is in recession then the coefficient for each variable is the appropriate element of matrix β_1 and the slope is α_1; however, if the economy is in expansion, then intercept is equal to the sum of appropriate elements of α_1 and α_2, and the slope is the sum of β_1 and β_2. u_{it} represents the variance coefficients of a variance-covariance matrix of errors in two regimes,

and is normally distributed with zero mean ($u_{it} \sim N(0, \Sigma)$). The error term consists of two components:

$$u_{it} = \eta_i + v_{it} \tag{2}$$

where η_i is time-invariant panel fixed effect and v_{it} is idiosyncratic errors.

Using OLS in the current identification, where the right hand side contains lags of Y_{it} and the threshold variable is endogenous, $q_{i,t-1} = \Delta Y_{i,t-1} = Y_{i,t-1} - Y_{i,t-2}$, will not provide unbiased estimates. However, GMM estimators will ensure consistent estimates of the parameters. The parameters we want to estimate are the set of coefficients $\theta = (\alpha_1, \alpha_2, \beta_1, \beta_2)$ as in a linear model, and in additional, threshold parameter (γ). If γ is defined then the model becomes linear in other parameters, and one can estimate them using standard methods. The model is non-linear in γ, and therefore standard optimization techniques are not applicable, and a more convenient way to find threshold variable will be a grid search:

$$\hat{\gamma} = \arg\min_{\gamma \in \Gamma} S(\gamma) \tag{3}$$

where $S(\gamma) = \hat{e}(\gamma)'\hat{e}(\gamma)$ is the sum of squared residuals.

We use Hansen (1999) to test whether the threshold indicator is statistically significant or not. Under the null hypothesis ($\beta_2 = 0$), the threshold parameter is not identified, so the estimator has non-standard distribution. Hansen (1999) proved that $\hat{\gamma}$ is a consistent estimator for true γ, and he argued that the best way to test $\gamma = \gamma_0$ is to form the confidence interval using the "no-rejection region" method with a likelihood-ratio ($\mathcal{LR}$) statistic, as follows:

$$\mathcal{LR}(\gamma) = \frac{S_0 - S_1(\hat{\gamma})}{\hat{\sigma_1}} \xrightarrow{\Pr} \xi \tag{4}$$

where S_0 and S_1 are the sum of squared residuals under H_0 and H_1. ξ is a random variable with distribution function:

$$Pr(x < \xi) = (1 - \epsilon^{\frac{-x}{2}})^2 \tag{5}$$

Testing for a threshold effect is the same as testing for whether the coefficients are the same in each regime. Results as depicted in Table-A2 (Panel A) reject linearity hypothesis.[2]

We choose γ that minimizes residuals; after γ is fixed we run the model as a linear model and find other parameters:

$$\hat{\theta} = \arg\min_{\theta \in \Theta} g(\theta)' W g(\theta) \tag{6}$$

Figure A2 depicts the results from the grid search where the horizontal line is the normalized GDP growth ($\frac{\Delta GDP}{max|\Delta GDP|}$) and the vertical line is the Root Mean Squared Error (RMSE) from estimation conditional on $\hat{\gamma} = l, l \in [-0.5, 0.5]$. We can observe that the case $\hat{\gamma} = 0$ belongs to the area where RMSE is minimized.

With the implementation of regime-switching, the whole sample is divided into multiple subsamples corresponding to different regimes. The problem is that some of these subsamples may cover few observations. This may challenge the reliability of the estimates due to a short time series. Extending the VAR model to multiple country dimensions may overcome this obstacle. Therefore, the PTVAR model increases the efficiency of the model's elements.

While the majority of the studies in the threshold literature belong to the static model (e.g., Hansen, 2000; Seo and Linton, 2007), our model belongs to the group of dynamic models with endogenous threshold, as in Seo and Shin (2016) and Kourtellos et al. (2016). We allow for the threshold variable q_{it} being endogenous, and employ GMM techniques to obtain consistent estimates. The reason behind this choice is that using least squares while the lagged dependent variable and the threshold variable in the right-hand are correlated with the error term results with a bias in coefficients. To solve this issue, Dang et al. (2012) have proposed the generalized GMM estimator in the dynamic panel context, which can provide consistent estimates of the parameters. Additionally, Seo and Shin (2016) also rely on an analogical solution in a similar framework, applying GMM methodology.

[2] We arranged balanced data due to the requirement of STATA application.

5 Model Estimations

The main research question of the current study is how fiscal policy is reflected across different regimes when the economy is experiencing downturn or recovery. We are interested in the asymmetric pattern of responses in the government policy in developing countries. The importance of this result is twofold: Firstly, our paper is the first work documenting asymmetry in developing countries. Additionally, it reveals a more accurate size of the fiscal multiplier for developing countries during an economic downturn and recovery, which enables us to evaluate the efficiency of fiscal policy for developing countries as well.

We obtained GMM estimates following the panel VAR estimation provided by Abrigo and Love (2016). Asymmetry in the series of GDP is governed by adding an exogenous variable that is simply the intersection of a dummy standing for decline in GDP and GDP itself. Additionally, as suggested in Abrigo and Love (2016), cluster specific error terms are eliminated by Forward Orthogonal Deviation (FOD). FOD was first developed by Arellano and Bover (1995) as an alternative to the first difference method in panel data models. In this approach, instead of using past realization, it subtracts the average of available future realizations and minimizes data loss. Additionally, following most of the literature (e.g., Blanchard and Perotti, 2002; Romer and Romer, 2010; Ko and Morita, 2013), we include four lags to the right-hand side of the equation.

A brief summary of the results reveals the following picture: During economic downturns both developed and developing countries experience a positive impact of government intervention; however, it is significantly lower than the effect of government expansion during economic recovery periods. The main economic mechanism generating the stated patterns could be closely related the investment and saving decisions of the agents in the economy. A lower fiscal multiplier during an economic downturn might be the consequence of the precautionary or defensive strategy of the private sector on economic decisions such as investment, and/or research and development costs, which restrains the high pace of economic growth induced by the increase in government spending. However, during the period of economic recovery switching from a conservative strategy to a more optimistic and aggressive one can lead to a higher fiscal multiplier.

The same mechanism can also explain the second contradictory result of this study that

Table 1: Forecast-Error Variance Decomposition with Different Regimes

		Recovery periods					
		Developed countries			Developing countries		
	Horizon	GOV	TAX	GDP	GOV	TAX	GDP
GDP	1	0.819	0.002	0.179	0.588	0.018	0.395
	2	0.856	0.002	0.142	0.599	0.028	0.373
	3	0.866	0.002	0.132	0.612	0.027	0.360
	4	0.867	0.002	0.131	0.628	0.025	0.348
	5	0.866	0.003	0.131	0.632	0.025	0.342
	6	0.865	0.004	0.131	0.634	0.026	0.339
	7	0.865	0.004	0.131	0.635	0.027	0.338
	8	0.865	0.004	0.131	0.635	0.027	0.337
	9	0.865	0.004	0.131	0.636	0.027	0.337
	10	0.865	0.004	0.131	0.636	0.027	0.337
		Downturn periods					
		Developed countries			Developing countries		
	Horizon	GOV	TAX	GDP	GOV	TAX	GDP
GDP	1	0.723	0.004	0.272	0.396	0.222	0.382
	2	0.703	0.005	0.292	0.391	0.231	0.378
	3	0.697	0.006	0.297	0.391	0.231	0.378
	4	0.696	0.007	0.296	0.391	0.231	0.378
	5	0.697	0.008	0.296	0.392	0.231	0.377
	6	0.696	0.008	0.296	0.392	0.231	0.377
	7	0.696	0.008	0.297	0.392	0.231	0.377
	8	0.696	0.008	0.297	0.392	0.231	0.377
	9	0.696	0.008	0.297	0.392	0.231	0.377
	10	0.696	0.008	0.297	0.392	0.231	0.377

Notes: While the first part represents a recovery period of the variance decomposition of forecast errors, the second represents a downturn period. Column (3)-(5) represent the developed countries sample, columns (6)-(8) represent developing countries.

the fiscal multiplier in the developing countries is higher when the economy is in a good state. Developing economies experience larger fluctuations under different phases of the business cycle. This means that during a period of economic decline, the domestic economy experiences larger shrinkage. As the economy operates far below its potential level, switching to an expansionary phase is characterized by a higher fiscal multiplier. Additionally, the higher multiplier might be triggered by the spillover effect from the developed countries, as they are the main leading element of business cycles, considering the fact that different regimes across both groups mostly coincide. The major proportion of the economy is controlled by the government in developing countries and the private sector is relatively small; therefore, when the economy is switching from a downturn to recovery, the fiscal multiplier has larger impacts.

We assess the relative contribution of government spending shocks in output fluctuations. We computed forecast error variance decompositions (FEVDs) to investigate the role of shock. Table 1 displays the contribution of each structural shock to the FEVDs of output fluctuations based on the regime-switching model estimation. Comparing each panel of FEVDs, we find that the relative role of government spending shocks differs among regimes. For developing countries

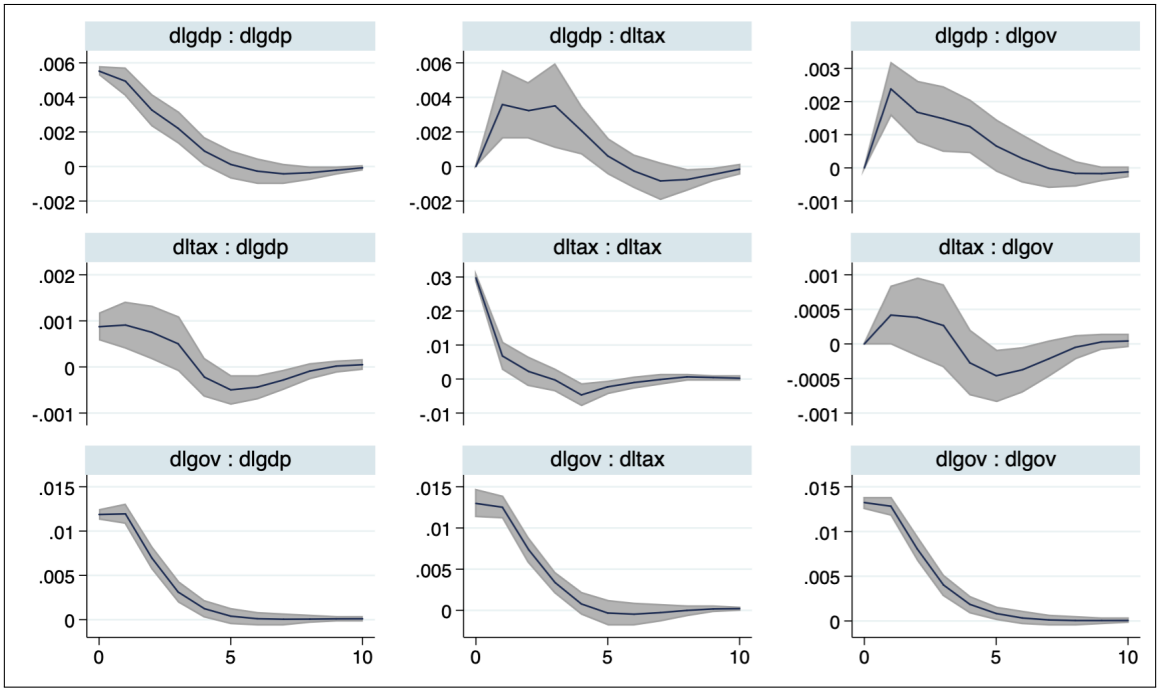
it is 65 % during a recovery period, but this number reduces to 40 % when the economy experiences a downturn. For developed countries, however, the contribution of government spending shock is significantly higher, at 85% and 70 % in both recovery and downturn periods respectively. Although we see a decrease in the contribution when we shift to a downturn from the economic recovery, compared to developing countries it is not much, and the relative contribution is significantly larger. Overall, our FEVD results indicate that the contribution of fiscal shocks is substantially different depending on the regimes.

The most important finding of our research is an asymmetry in the response of GDP with regard to the economic situation. The impulse response functions reveal the asymmetry in the behavior of GDP in reaction to a government spending shock in the different states of the economy. However, in contrast to most of the literature (e.g., Auerbach and Gorodnichenko, 2012; Baum et al., 2012; Riera-Crichton et al., 2015), our results show that the size of the GDP response is larger when the economy is in recovery. Additionally, we found that the size of the impulse responses is higher for developing countries in both the economic downturn and recovery states. This result also does not stand in line with most of the studies (e.g., Ilzetzki et al., 2013; Estevo and Samak, 2013; Arin et al., 2015; Ferraresi et al., 2015) that found a smaller effect in developing countries compared to developed ones. Ilzetzki et al. (2013) claimed that the fiscal multiplier for emerging economies has been found to be positive, but not substantially greater than zero. So far, only Contreras and Battelle (2014) found a similar result that fiscal multiplier is larger in developing than in developed countries.

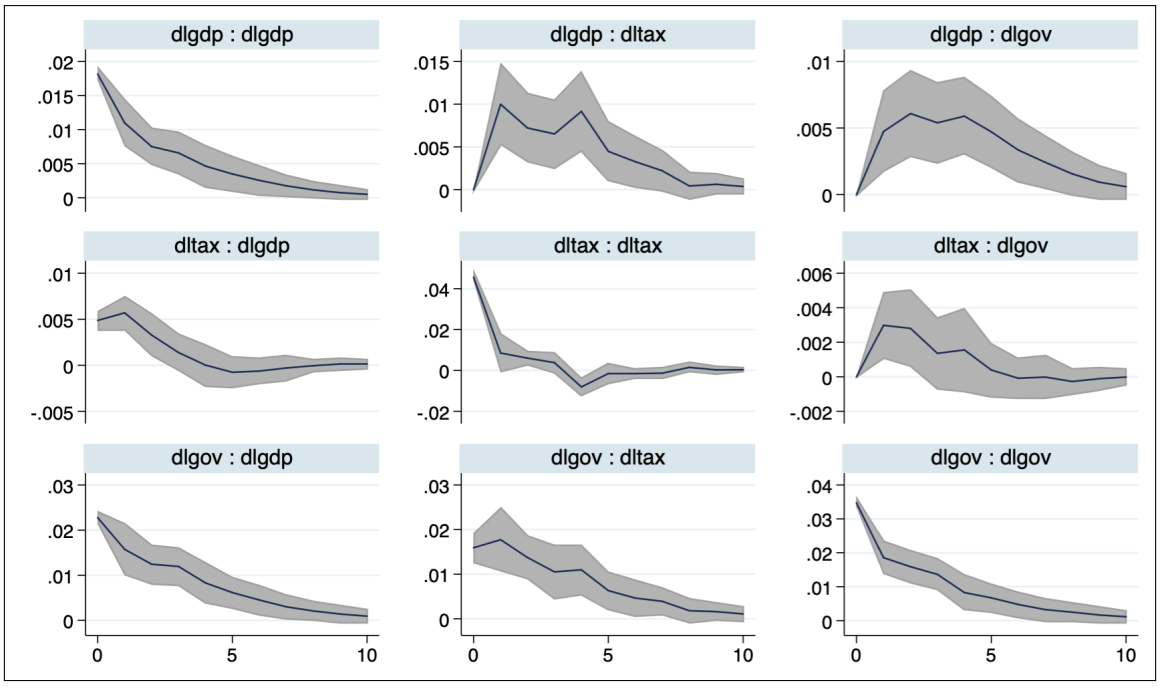
The main explanation of a larger fiscal multiplier in developing countries might be that consumption smoothing behavior is less prevalent in developing countries. This relates to higher financial constraints, as well as agents being less forward looking if there is too much instability (Batini et al., 2014). Additionally, lower automatic stabilizers in developing countries increase fiscal multipliers (Dolls et al., 2012), and relatively lower public debt in developing countries is expected to entail higher multipliers (Ilzetzki et al., 2013).

Figure 1 depicts the orthogonalised impulse response function during economic recovery periods for developed and developing countries, respectively. We are mainly interested in the response of GDP to government expenditure shock, which is represented in the lower-left corner. The figures show that the effect is positive and statistically significant. Despite the patterns

Figure 1: Impulse Response Functions for Countries during "Recovery"



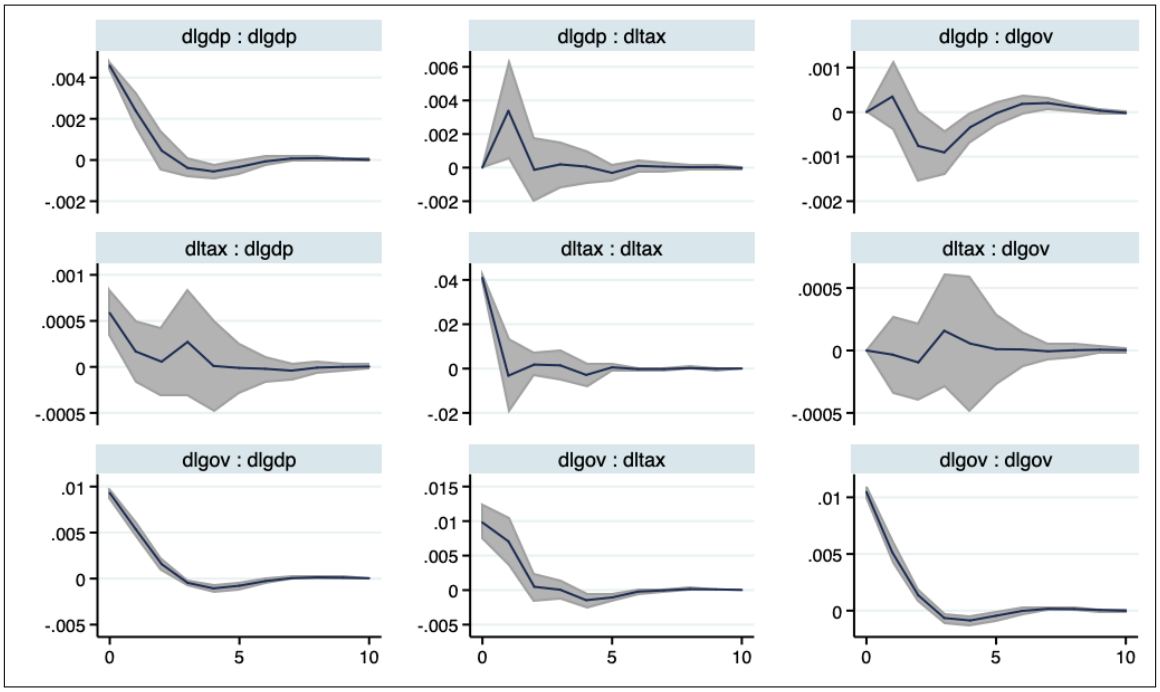
(a) IRFs for *developed* countries during "Recovery"



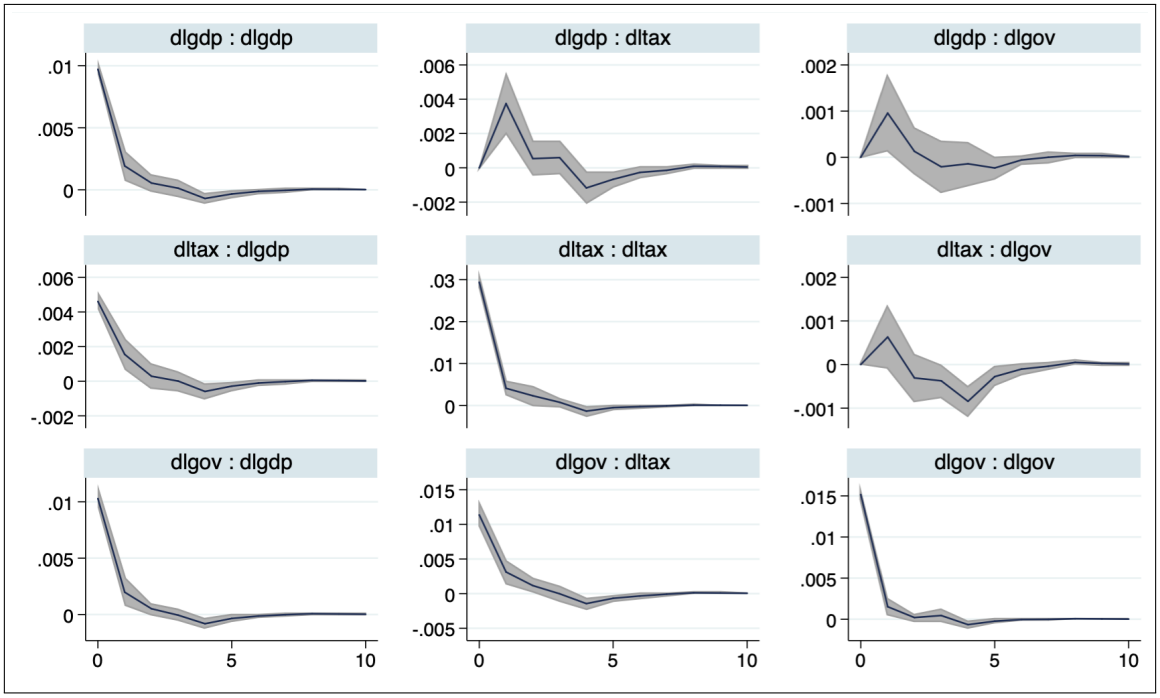
(b) IRFs for *developing* countries during "Recovery"

Notes: The response of GDP to government expenditure shock during a recovery period represented in the lower left corner for developed countries in part (a), and for developing countries in part(b). The impact is 0.012 at the first period for developed countries during recovery period and double to the corresponding effect for developing countries with 0.023.

Figure 2: Impulse Response Function for Countries during "Downturn"



(a) IRFs for *developed* countries during "Downturn"



(b) IRFs for *developing* countries during "Downturn"

Notes: The response of GDP to government expenditure shock during a downturn period represented in the lower left corner for developed countries in part (a), and for developing countries in part(b). The impact is 0.009 at the first period for developed countries during downturn period and corresponding effect for developing countries is close with 0.010.

being similar for both groups, in magnitude responses for the developing countries are twice as high. The impact is 0.023 in the first period for developing countries during a recovery period, which is almost double the corresponding effect for developed countries, where it is 0.012. Multiplying the impact responses with the ratio of average GDP to government expenditure, we obtain impact a fiscal multiplier which is 0.15 and 0.08. These numbers mean that in the developing countries the economy grows for 0.15 per each unit of money spent by the government, whereas in developed countries growth is only 0.08.

The next two graphs in Figure 2 depicts IRF during an economic downturn. These graphs show that the reaction of GDP to government expenditure shock in developing countries is also larger during economic downturn than in developed countries, however the difference is not as large as it was in the previous case. The size of the responses is 0.010 and 0.009, and the impact of fiscal multipliers are 0.06 and 0.05. Our result does not stand in line with the pioneering work by Auerbach and Gorodnichenko (2012), which found that the government spending multiplier is at least 2-3 times less in expansions than in recessions. Mittnik and Semmler (2012) produced similar results with a one percent output shock inducing a 1.3% change on output growth and 1.8% on employment growth in states of low growth, but 1.1% and 0.7% respectively in the state of high growth. It should be noted that the two previous models used only US data and applied multivariate TAR (or STAR) model in their analysis.

Our result is also not lined with the findings of Arin et al. (2015), who use a Markov Switching Model to investigate the effectiveness of fiscal policy in the post-WW2 period of the US economy, with quarterly frequency. The authors also confirm that the state of the economy matters for the fiscal multiplier, but it tends to be higher in "recession" periods compared to "expansion" periods. The responses of spending multipliers are higher during a downturn, while the impacts of the tax multiplier are higher during recovery. However, research by Contreras and Battelle (2014) has a similar conclusion, where the fiscal multiplier is positive and close to one for developing countries, but not statistically different from zero for advanced economies using the panel Structural VAR model, which according to the authors captures the correlation between the error terms and the explanatory variables.

Our findings question previous conclusions drawn in the literature on fiscal multipliers. The main drivers of those findings may be related to the sample size and the choice of method-

ology. Contrary to previous studies, we found that the fiscal multiplier is larger in developing than in developed countries, and it is mainly larger during times of recovery. These findings have important implications in developing countries for policymakers to be able to estimate and use the fiscal multiplier better, which plays a key role in ensuring macroeconomic forecasting accuracy. As is confirmed, fiscal policy in different economic phases, particularly in recovery period, can be a more effective as development tool for developing countries.

Robustness check

We conduct the robustness exercises for our headline findings. We take the Ilzetzki et al. (2013) (IMV) dataset from the public version posted with their publication. First, using the IMV dataset, we are able to replicate the results for linear models reported in their paper. Then, we check non-linearity based on the method proposed by Hansen (1999). We reject the hypothesis of linearity in IMV dataset. Threshold test results are presented in Table-A2 (Panel B).[3] We calculate the government consumption expenditure as the aggregate of public consumption and investment in their case to facilitate comparisons with our results. Next, we implied our non-linear methodology (PTVAR) to IMV dataset.

When we use the sample of countries present in IMV datasets to analyze the multipliers in developing vs. developed countries (as well as "recovery" vs. "downturn"), we still confirm our baseline findings. We analyze the effect of having different two sets of countries and two distinct regimes in the sample. This is the key factor explaining the differences in results. IMV dataset represents a higher fiscal multiplier in developed countries compared to developing ones using linear modeling (see Appendix, Figure A3). Since we reject the hypothesis of linearity in IMV dataset, we run all samples, then separated two different subsamples: developed vs. developing. In all cases, "recovery" period have a higher multiplier than "downturn" period. IMV's linear specification results are presented as averaged of those two periods. While the difference is bigger in developing countries, it is very small in developed ones. We confirm our headline findings that the "recovery" period and developing countries have a higher fiscal multiplier (see Appendix, Figure A4) compared to the "downturn" and developed countries, respectively.

[3] We arranged balanced data due to the requirement of STATA application.

6 Conclusions

Fiscal policy and its effects on the economic development of developing countries remain a major area of discussion. The discrepancies in this topic involve both theoretical background and empirical issues. Our research investigated the effect of fiscal policy under economic *downturns* and *recoveries* for developing economies. The main purpose of our paper was to assess whether there is an asymmetry in the response of GDP to government expenditure shock with regard to the economic phases. Our model enriches the literature of regime-switching models using a non-linear panel threshold vector autoregression (PTVAR) model to measure the size of the fiscal multiplier for both developing and developed countries, taking into account whether the economy is experiencing "downturn" or "recovery".

Our main finding shows that the size of the fiscal multiplier in developing economies is underestimated. Most of the studies in the literature of fiscal multiplier are interested in developed countries, especially for the U.S., due to data availability. However, there are limited studies that address the impact of fiscal policy in developing countries. The differences between developing and developed countries with regard to the fiscal multipliers are related to the structural characteristics and fiscal-policy transmission channels of these countries. Since developing countries have higher average return, larger government size in economies, and lower average public debt compared to the developed ones, developing economies therefore have larger fiscal multipliers.

Considering the previous literature on non-linear models employed in fiscal policy, our results show a significantly larger fiscal multiplier during economic "recovery" periods compared to economic "downturn". Our finding contradicts the majority of research exploring fiscal multipliers increase more in recession than they decrease in expansion periods. Our explanation is that precautionary savings are larger in a more uncertain environment; therefore, fiscal multipliers are lower in a *downturn*, then multipliers steadily increase when the initial spending shock occurs at the end of a *recession* and/or at the beginning of *recovery*.

As fiscal policy is the main policy issue in most developing countries compared to developed ones due to several factors (such as the relatively larger size and the strong role of government in these economies), it is important to know the real impact of the fiscal multiplier especially during downturn and recovery for these group of countries. Our results find

significant evidence that the effectiveness of fiscal policy enhances developing economies "recovery" from "downturn". Underestimating fiscal multipliers may lead developing countries to set unachievable fiscal targets.

Funding:

Zeynalov acknowledges support from the University of Economics, Prague - IGA (grant: IG212039).

References

Abrigo, M. R. and Love, I. (2016). Estimation of panel vector autoregression in Stata. *The Stata Journal*, 16(3):778–804.

Afonso, A., Baxa, J., and Slavík, M. (2018). Fiscal developments and financial stress: a threshold VAR analysis. *Empirical Economics*, 54(2):395–423.

Arellano, M. and Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, 68(1):29–51.

Arin, K. P., Koray, F., and Spagnolo, N. (2015). Fiscal multipliers in good times and bad times. *Journal of Macroeconomics*, 44:303–311.

Auerbach, A. J. and Gorodnichenko, Y. (2012). Measuring the output responses to fiscal policy. *American Economic Journal: Economic Policy*, 4(2):1–27.

Auerbach, A. J. and Gorodnichenko, Y. (2013). Fiscal multipliers in recession and expansion. In *Fiscal Policy after the Financial crisis*, pages 63–98. National Bureau of Economic Research, Inc.

Auerbach, A. J., Gorodnichenko, Y., and Murphy, D. (2019). Local fiscal multipliers and fiscal spillovers in the United States. Technical report, National Bureau of Economic Research.

Babecký, J., Franta, M., and Ryšánek, J. (2018). Fiscal policy within the DSGE-VAR framework. *Economic Modelling*, 75:23 – 37.

Bachmann, R. and Sims, E. R. (2012). Confidence and the transmission of government spending shocks. *Journal of Monetary Economics*, 59(3):235–249.

Batini, N., Eyraud, L., and Weber, A. (2014). A simple method to compute fiscal multipliers. IMF Working Papers 14/93, International Monetary Fund.

Baum, A., Poplawski-Ribeiro, M., and Weber, A. (2012). Fiscal multipliers and the state of the economy. IMF Working Papers 12/286, International Monetary Fund.

Blanchard, O. and Perotti, R. (2002). An empirical characterization of the dynamic effects of changes in government spending and taxes on output. *The Quarterly Journal of Economics*, 117(4):1329–1368.

Caggiano, G., Castelnuovo, E., Colombo, V., and Nodari, G. (2015). Estimating fiscal multipliers: News from a non-linear world. *The Economic Journal*, 125(584):746–776.

Canova, F. and Ciccarelli, M. (2013). Panel Vector Autoregressive models: A Survey. CEPR Discussion Papers 9380, Center fro Economic Policy Research, London.

Contreras, J. and Battelle, H. (2014). Fiscal multipliers in a panel of countries. Working Papers 2014-15, Banco de Mxico.

Dang, V. A., Kim, M., and Shin, Y. (2012). Asymmetric capital structure adjustments: New evidence from dynamic panel threshold models. *Journal of Empirical Finance*, 19(4):465–482.

Dolls, M., Fuest, C., and Peichl, A. (2012). Automatic stabilizers and economic crisis: US vs. Europe. *Journal of Public Economics*, 96(3-4):279–294.

Eggertsson, G. B. (2011). What fiscal policy is effective at zero interest rates? *NBER Macroeconomics Annual*, 25(1):59–112.

Estevo, M. M. and Samak, I. (2013). The economic effects of fiscal consolidation with debt feedback. IMF Working Papers 13/136, International Monetary Fund.

Fatás, A. and Mihov, I. (2001). The effects of fiscal policy on consumption and employment: Theory and evidence. CEPR Discussion Paper 2760, Center for Economic Policy Research, London.

Ferraresi, T., Roventini, A., and Fagiolo, G. (2015). Fiscal policies and credit regimes: A TVAR approach. *Journal of Applied Econometrics*, 30(7):1047–1072.

Guajardo, J., Leigh, D., and Pescatori, A. (2014). Expansionary austerity? International evidence. *Journal of the European Economic Association*, 12(4):949–968.

Hansen, B. E. (1999). Threshold effects in non-dynamic panels: Estimation, testing, and inference. *Journal of Econometrics*, 93(2):345–368.

Hansen, B. E. (2000). Sample splitting and threshold estimation. *Econometrica*, 68(3):575–603.

Hory, M.-P. (2016). Fiscal multipliers in emerging market economies: Can we learn something from advanced economies? *International Economics*, 146(146):59–84.

Ilzetzki, E., Mendoza, E. G., and Vegh, C. A. (2013). How big (small?) are fiscal multipliers? *Journal of Monetary Economics*, 60(2):239–254.

Ilzetzki, E. and Vegh, C. A. (2008). Procyclical fiscal policy in developing countries: Truth or fiction? NBER Working Papers 14191, National Bureau of Economic Research, Inc.

Ko, J.-H. and Morita, H. (2013). Regime switches in japan's fiscal policy: Markov-switching var approach. *The Manchester School*.

Kourtellos, A., Stengos, T., and Tan, C. M. (2016). Structural threshold regression. *Econometric Theory*, 32(4):827–860.

Kraay, A. (2012). How large is the government spending multiplier? evidence from world bank lending. *The Quarterly Journal of Economics*, 127(2):829–887.

Mittnik, S. and Semmler, W. (2012). Regime dependence of the fiscal multiplier. *Journal of Economic Behavior & Organization*, 83(3):502–522.

Perotti, R. (2005). Estimating the effects of fiscal policy in OECD countries. CEPR Discussion Paper 168, Center for Economic Policy Research.

Rafiq, S. (2014). UK fiscal multipliers in the postwar era: Do state dependent shocks matter? *CESifo Economic Studies*, 60(1):213–245.

Ramey, V. A. (2011). Identifying government spending shocks: It's all in the timing. *The Quarterly Journal of Economics*, 126(1):1–50.

Ramey, V. A. and Shapiro, M. D. (1998). Costly capital reallocation and the effects of government spending. In *Carnegie-Rochester Conference Series on Public Policy*, volume 48, pages 145–194. Elsevier.

Riera-Crichton, D., Vegh, C. A., and Vuletin, G. (2015). Procyclical and countercyclical fiscal multipliers: Evidence from oecd countries. *Journal of International Money and Finance*, 52:15–31.

Romer, C. D. and Romer, D. H. (2010). The macroeconomic effects of tax changes: Estimates based on a new measure of fiscal shocks. *American Economic Review*, 100(3):763–801.

Seo, M. H. and Linton, O. (2007). A smoothed least squares estimator for threshold regression models. *Journal of Econometrics*, 141(2):704–735.

Seo, M. H. and Shin, Y. (2016). Dynamic panels with threshold effect and endogeneity. *Journal of Econometrics*, 195(2):169–186.

Sims, C. A. (1980). Macroeconomics and reality. *Econometrica: Journal of the Econometric Society*, pages 1–48.

Tsay, R. S. (1998). Testing and modeling multivariate threshold models. *Journal of the American Statistical Association*, 93(443):1188–1202.

Uhlig, H. (2005). What are the effects of monetary policy on output? Results from an agnostic identification procedure. *Journal of Monetary Economics*, 52(2):381–419.

Woodford, M. (2011). Simple analytics of the government expenditure multiplier. *American Economic Journal: Macroeconomics*, 3(1):1–35.

Appendix

Table A1: **List of Countries**

Developing countries		Developed countries	
Armenia	Kazakhstan	Australia	Israel
Belarus	Kyrgyz Republic	Austria	Italy
Botswana	Malaysia	Belgium	Japan
Brazil	Peru	Canada	Netherlands
Chile	Philippines	Czech Republic	Norway
China, P.R.: Macao	Russia	Denmark	Spain
Georgia	Singapore	Finland	Sweden
Guatemala	Thailand	Germany	United Kingdom
Indonesia		Ireland	

Table A2: **Thresholds**

Threshold variable	Estimated threshold	Lower threshold	Upper threshold	F-stat	Sample	Observation
Panel A - Benchmark model						
GDP growth	-0.134	-0.158	-0.127	31.81	1995Q1-2015Q4	1568
Panel B - Ilzetzki et al. (2013)'s dataset						
GDP growth	-0.022	-0.022	-0.022	58.85	2000Q1-2005Q4	880

Figure A1: Average Quarterly GDP Growth of Developed and Developing Countries, 1995-2016

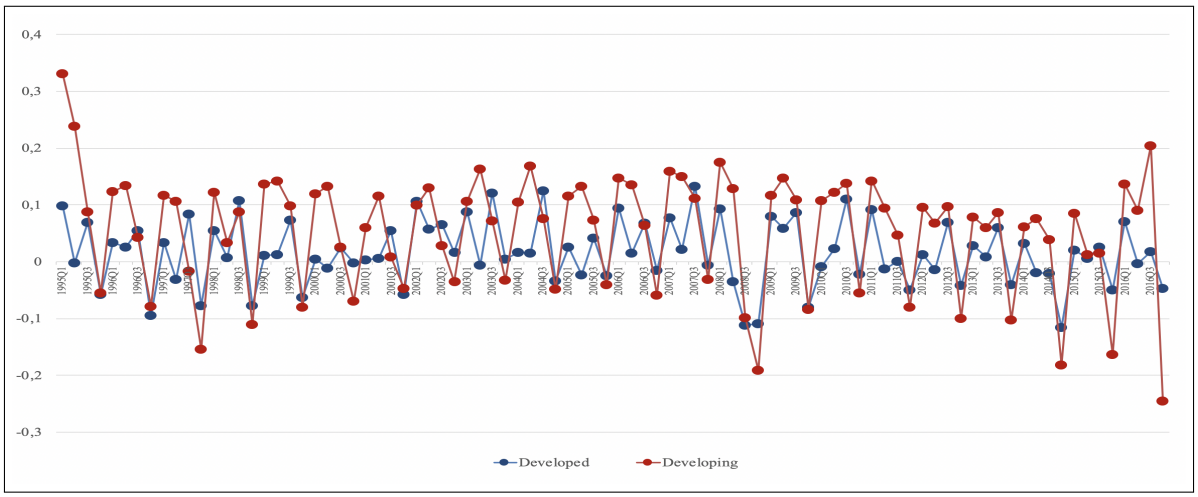
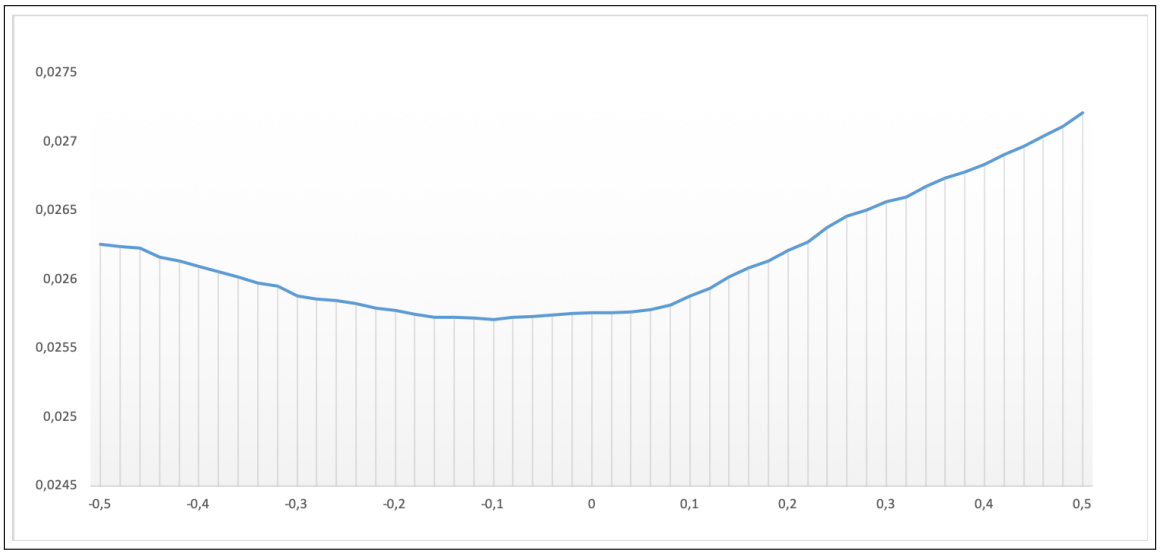
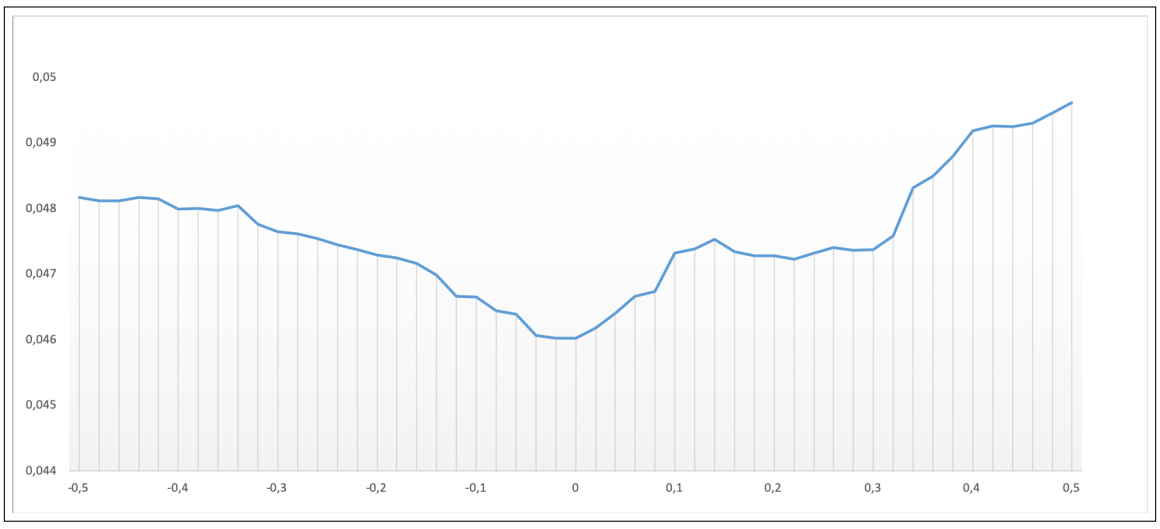


Figure A2: Root Mean Square Errors with Threshold Value



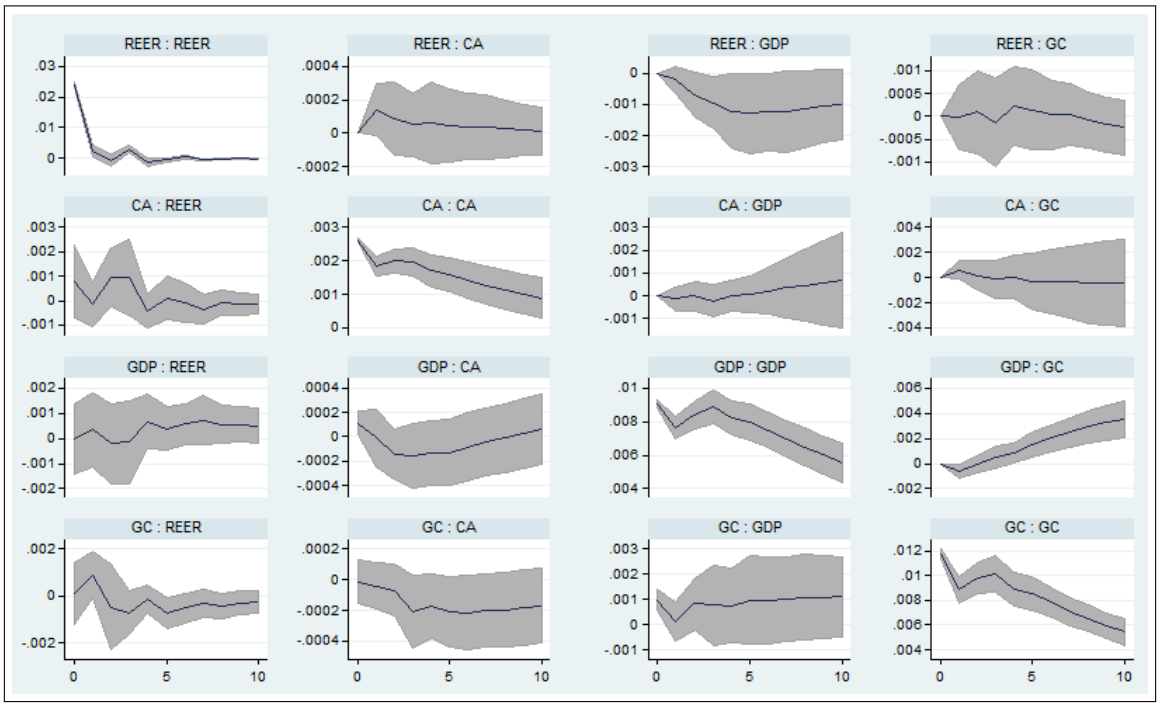
(a) Developed countries



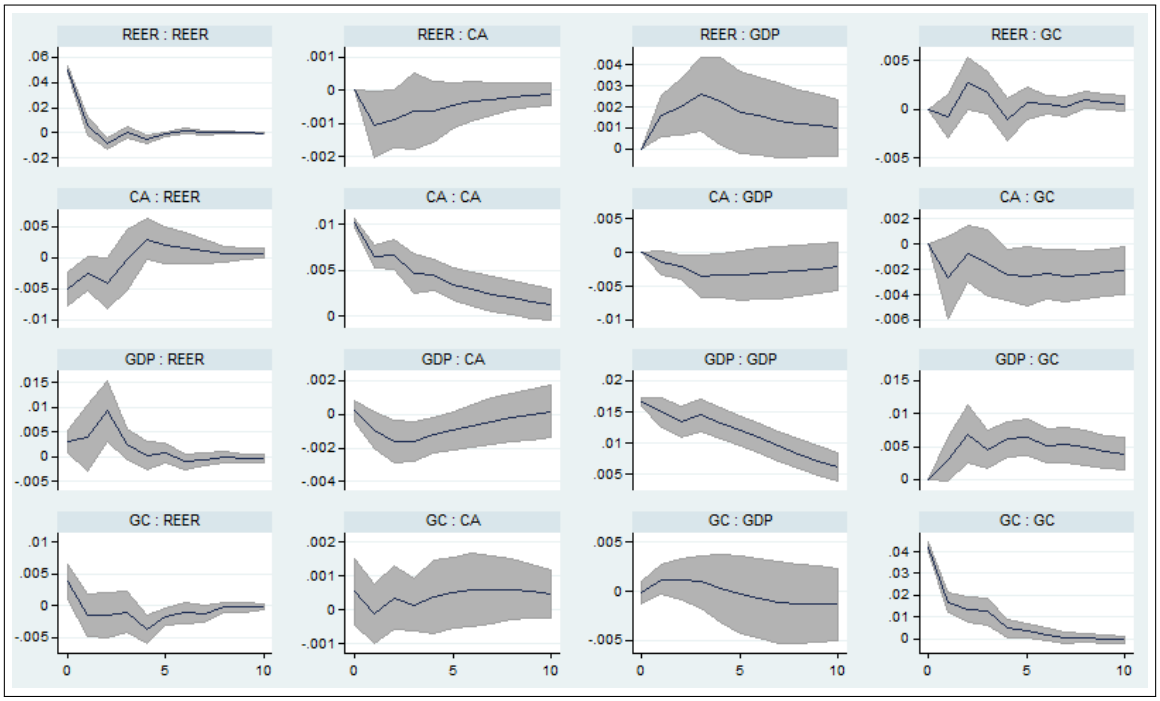
(b) Developing countries

Notes: Horizontal line is the normalized GDP growth and vertical line is the Root Mean Squared Error (RMSE) from estimation conditional on threshold.

Figure A3: Impulse Response Functions for Countries in IMV dataset

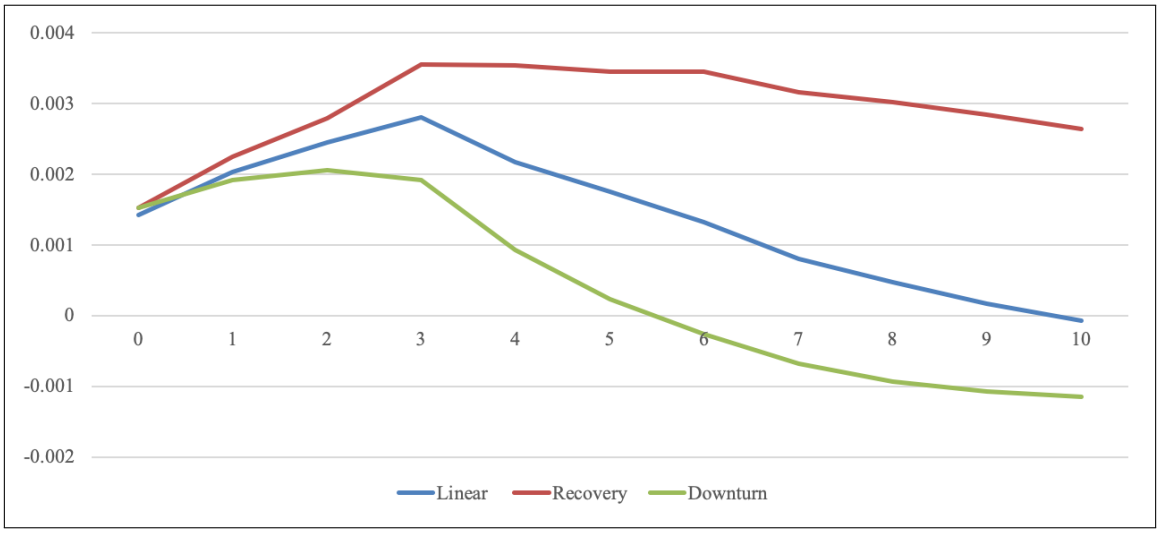


(a) IRFs for *developed* countries

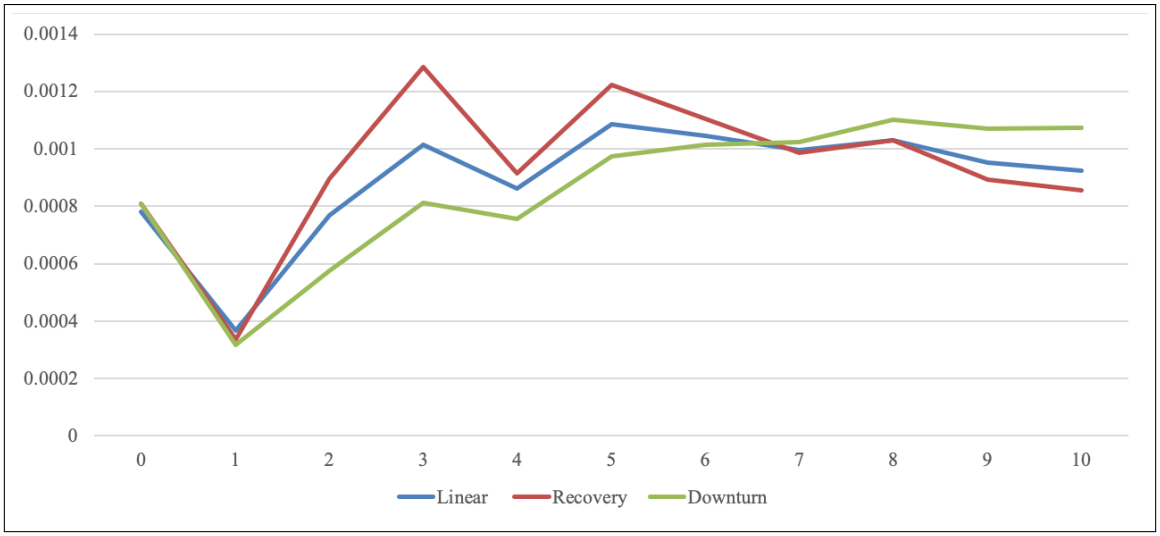


(b) IRFs for *developing* countries

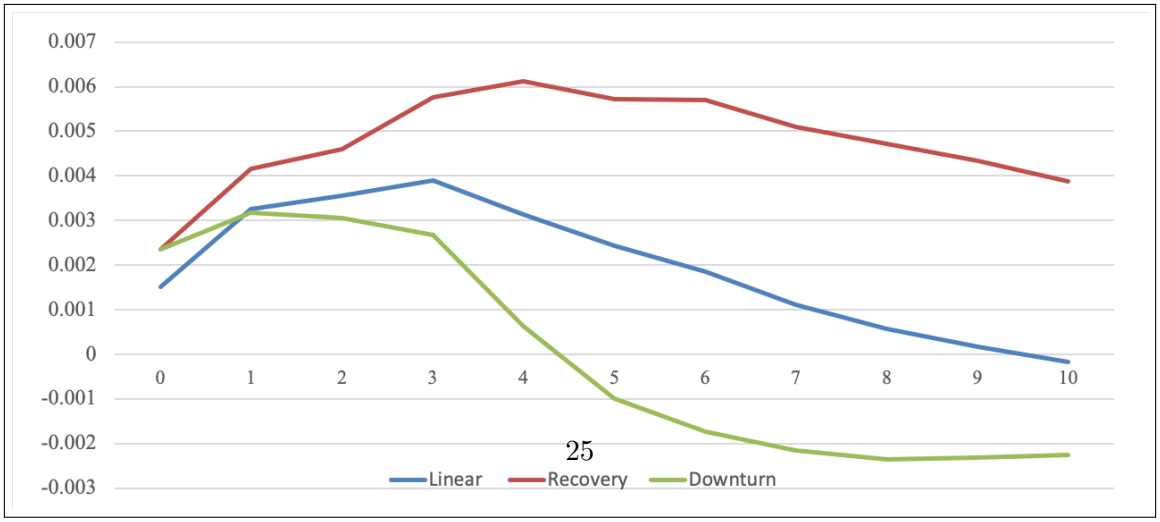
Figure A4: IRFs for countries in IMV dataset



(a) All countries



(b) Developed countries



(c) Developing countries