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31 April 2015

Output Effects of Fiscal Stimulus in Central and Eastern European Countries

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Abstract: In spite of the rapidly growing research on fiscal multipliers over the recent years, little evidence has been so far accumulated in developing and emerging economies. This paper investigates the nature and the size of fiscal multipliers in Central and Eastern European Countries (CEEC). Unlike most of existing literature, we draw upon a panel vector error correction model, which appropriately captures the common long-term path of CEEC, while allowing for different short-run dynamics, in an integrated setup. Our main results show that the spending multiplier is positive, but low on average. Moreover, its sign, significance and magnitude vary across CEEC. Finally, both impulse and cumulative fiscal multipliers are sensitive to a wide range of CEEC characteristics, including the exchange rate regime, the level of economic development, the fiscal stance, and the openness degree.

JEL Classification: E62, O11, P35

Keywords: Central and Eastern European Countries; fiscal multipliers; panel vector error correction model.

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I. Introduction

The fiscal multiplier has received a renewed attention since the recent financial crisis and the widespread fiscal stimulus implemented by many countries around the world. In spite of the rapidly growing research on fiscal multiplier over the recent years, so far little evidence has been accumulated in emerging and developing economies.[1]

In this paper, we develop the literature by investigating the effect of discretionary fiscal change on economic activity in 11 Central and Eastern European Countries (CEEC). CEEC share some specific characteristics that may affect the multiplier. Specifically, they are relatively small open economies with relatively low debt levels, and are currently implementing structural reforms that are more or less correlated with the accession to the European (Monetary) Union (E(M)U). In this respect, assessing the nature and the size of the effects of fiscal stimulus is of great interest to implement a more tailored fiscal policy.

The contribution of our paper is fourfold. First, unlike the existing literature that relies extensively on VAR models, our analysis uses a Panel Vector Error Correction model (PVECM), selected for its appealing features for CEEC. Indeed, on the one hand, all CEEC in our sample are expected to follow a common dynamic in the long-term, driven by their integration process in the E(M)U. As such, drawing upon methods that remove this long-term dynamic (for example, through first-differentiation, as this is the case in stationary VAR models), would significantly affect the estimation of fiscal multipliers. On the other hand, albeit following a common long-run path, CEEC may present different short-run dynamics. Models that do not account for such country-heterogeneities (such as PVAR) or abstract of the common long-run path (such as individual country-estimated VAR) are equally likely to produce biased estimations of fiscal multipliers. Consequently, unlike most studies, we take full advantage of the statistical properties of the data, and particularly of co-integration between variables, by using an error correction model on a panel data setting. This methodology is appropriate for computing both pooled and country-specific fiscal multipliers within the same framework, while controlling for the common long-run relationship between CEEC.

Second, a crucial issue is related to the identification of truly exogenous fiscal shocks. However, most VAR models rely upon a simple Cholesky-decomposition of shocks, in which identification arises from the ordering of variables. In this paper, we draw upon Fatas and Mihov (2003, 2006), Afonso et al. (2010) and Agnello et al. (2013), and define spending

[1] The next section discusses the contributions devoted to developing and emerging countries.

shocks as the cyclically-adjusted component of government spending. By so doing, we isolate an unexpected change in fiscal policy as the source of fiscal shocks.

Third, we employ genuine (i.e. not interpolated) quarterly data for the period 1999q1-2013q3. The use of quarterly data to compute multipliers is extremely rare: if we take into account the VAR-based literature, Ilzetzki et al. (2013) is such an example. These authors state that the use of quarterly data is useful for identifying shocks properly. In addition, compared to Ilzetzki et al. (2013), we exploit only one source to collect quarterly data, which ensures homogenous data for our panel of CEEC.

Fourth, after presenting pooled and country-specific multipliers, we explore the sensitivity of the effect of fiscal policy by disentangling CEEC across several of their major characteristics, namely the exchange rate regime (ERR), the level of economic development, the fiscal stance, and the openness degree.

Our results are as follows. First, we find that impact and four-quarter cumulative multipliers are positive and significant for CEEC. Although the size of impact multipliers is fairly small, namely between 0.07 and 0.09 (depending on the estimation method), cumulative multipliers can be up to four times higher compared to impact multipliers, namely between 0.21 and 0.31. Second, we unveil significant differences among fiscal multipliers across CEEC. Although positive in most countries, impact and cumulative multipliers can be statistically not significant or even negative in some CEEC. In addition, the magnitude of cumulative multipliers differs by a factor of four between CEEC, and climbs up to a large value of 0.7. Third, we show that not accounting for a common (instead of country-individual) long-term path can leave to important significance and size differences for fiscal multipliers in several CEEC of our sample. Finally, both impact and cumulative fiscal multipliers are sensitive to CEEC specificities. Albeit the ERR is found to be unimportant for output's response to fiscal shocks on impact, the ERR affects its cumulative response; in particular, cumulative multipliers are significant in pegged and floating ERR, and not significant in intermediate ERR. Next, both impact and cumulative multipliers are mainly significant in relatively less developed CEEC and in CEEC with relatively lower debt-to-GDP ratios. Finally, consistent with the predictions of the Mundell-Fleming model, we find that cumulative multipliers are significant only in relatively less open CEEC.

The rest of the paper is structured as follows. Section II summarizes the findings of previous studies. Section III presents the data and outlines the methodology. Section IV illustrates the main results. Section V discusses the sensitivity of fiscal multipliers to several CEEC structural characteristics, and Section VI concludes.

II. Literature review

The major fiscal stimuli implemented by governments in response to the recent crisis reopened the topic of the multiplier in academia.[2] As pioneered by Keynes (1936), the multiplier predicts a more than 1 to 1 change in GDP following a fiscal shock. However, as emphasized by Blanchard and Leigh (2013), the IMF was significantly under-evaluating fiscal multipliers. According to Marglin and Spiegler (2013), such conflicting findings are engendered by the use of different methodologies, time span, type of government spending, and, according to Chahrour et al. (2012), different identification methods for fiscal shocks.

Indeed, the literature devoted to the estimation of fiscal multipliers is particularly rich, and involves the use of many methods. Theoretically, fiscal multipliers can be approached using (i) the ISLM model in its static (Hicks, 1937) and dynamic (Blanchard, 1981) forms, (ii) RBC models, developed under the New Classical economics (Long and Plosser, 1983), and (iii) New Keynesian DSGE models (Gechert and Will, 2012). Econometrically, fiscal multipliers can be computed using (i) the Narrative Approach (Romer and Romer, 2010), (ii) the Vector AutoRegression (VAR) models (Blanchard and Perotti, 2002), (iii) single-equations models (Barro and Redlick, 2009), (iv) instrumental variables (Nakamura and Steinsson, 2014), (v) panel models (Almunia et al., 2010), and (vi) two-stage residual techniques (Agnello et al., 2013).

Due to the large strand of literature that focused on estimating fiscal multipliers, we present in the following the results of the studies that are the closest to our paper, by focusing on developing countries. Based on the estimation of elasticities and regressions to isolate fiscal shocks, IMF (2008) illustrates spending multipliers of 0.2 (-0.2) after one (two) years. Such low spending multipliers equally emerge from the PVAR analysis of Ilzetzki & Végh (2008), performed on 27 developing countries, namely 0.6/0.4/0.1 on impact/1st/2nd year. More recently, Kraay (2012, 2014) finds a spending multiplier of 0.5 (0.4) based on a sample of 29 (102) developing countries, while Ilzetzki et al. (2013) find public consumption multipliers equal to -0.03 (0.4) on impact (after 4 quarters). Finally, Minea & Mustea (2015) reveal short-lived impact and short-run fiscal multipliers for developing Asian and African Mediterranean countries. Overall, these studies emphasize that fiscal multipliers are fairly low in developing countries.

[2] At country level, many European countries took up bailout programs (30, 40, and 200 billion euros in France, Spain, and Greece, respectively). At supranational level, the EU and the US adopted fiscal packages of roughly 2% and 5% of their GDP for 2009-2010, respectively. According to the IILS (2011), fiscal stimuli during 2008-2009 were around 2 trillion USD for the G20 group, 9.1% of 2008 GDP in Asia and the Pacific (excluding Japan and South Korea), and 2.6% of 2008 GDP in Latin America and Caribbean.

III. Data and Methodology

We aim at empirically assessing output effects of a discretionary fiscal policy in CEEC. We begin by presenting the data, and then we expose the methodology.

3.1. Data

We use quarterly data for a sample of 11 CEEC over the period 1999q1-2013q3 (see Tables A.1a-b in Appendix for the list of countries and descriptive statistics).[3] Except for Central Government debt, which is measured by the quarterly public sector debt of the World Bank, all data are from EUROSTAT.

Two main reasons justify the choice of quarterly data. First, as compared to annual data, the use of quarterly data is crucial for capturing the fact that fiscal authorities can respond to output shocks as rapidly as only after one quarter (Ilzetzki et al., 2013). Second, quarterly data provide a substantial increase in the number of degrees of freedom compared to annual data, an important feature given the relative small time span usually available for European post-communist economies (hardly 15 years, in our study). In particular, as pointed out by Ilzetzki et al. (2013), interpolated quarterly data may lead to spurious regressions since, by construction, the interpolation creates a strong correlation between government spending and output. Thus, we use only genuine quarterly data, namely data that were originally collected at quarterly frequency.[4]

Our main variables are the gross domestic product (GDP), the total government expenditure, defined as the sum of the general government final consumption and gross fixed capital formation, and taxes, which include taxes on imports and exports less subsidies. Prior to their use in regressions, all variables are deflated by the consumer index (CPI) and seasonally adjusted using a moving-average filter.

3.2. Time series properties of variables

We explore time series properties of variables using three types of panel unit root tests. On the one hand, the Augmented Dickey Fuller (ADF) Fisher-type test of Choi (2001) and the Im, Pesaran and Shin (IPS, 2003) unit root test, which both assume the null hypothesis that all panels contain a unit root against the alternative of at least one stationary

[3] Although collected data cover the period 1992q2-2013q3, our sample starts in 1999q1 for several reasons. First, we allow CEEC to stabilize from the major imbalances engendered by the end of the Cold War. Second, we obtain a balanced sample with data collected at quarterly frequency.

[4] Most EU countries comply with the Common statistical standard in the European Monetary Union (ESA95), which encourages the collection of fiscal data at quarterly frequency. As such, CEEC in our sample started collecting quarterly-frequency data only since 1995.

panel. Compared to alternative tests (such as Levin, Lin and Chu, 2002), these tests present the advantages of allowing the autoregressive parameter to be country-specific and of not requiring panels to be strongly balanced. On the other hand, to account for the presence of a relatively weak number of countries and time dimension, which is inherent when analyzing CEEC, we equally draw upon the Levin, Lin and Chu (2002) unit root test.

Provided variables are integrated of the same order, we test in the following for cointegration. For this purpose, we revert to the cointegration tests coined by Westerlund (2007), which extend to panel data the time series test of Banerjee et al. (1998). These tests assume the null hypothesis of no cointegration. In particular, compared to alternative tests (such as, for example, the residual-based test of Pedroni, 2004), Westerlund (2007) tests were selected on the basis of allowing individual short-run dynamics and for remaining consistent in the presence of possibly serial-correlated errors and weak exogenous regressors.

3.3. The econometric model

In this sub-section, we discuss the error correction specification and the choice of the appropriate estimator. The use of the error correction framework can be justified both empirically and theoretically.

Empirically, the choice of the appropriate model strongly depends upon the statistical properties of the data. The existing literature on fiscal multipliers extensively resorts to the VAR methodology, either with country or panel data. However, the use of an error correction model is suitable when series are non stationary and cointegrated, as this is the case in our analysis.

From a theoretical standpoint, it is not unreasonable to assume that the effect of fiscal policy on output is not independent of the speed of adjustment to the long-run equilibrium, all the more given the common long-term path of CEEC, driven by their integration process in the E(M)U (see Nenovsky and Villieu, 2011). Therefore, it is suitable to account for the long-run equilibrium when assessing the response of output to the fiscal impulse.

In line with Pesaran et al. (1999), we assume an autoregressive distributed lag model (ARDL), with p lags for the dependent variable and q lags for each of the RHS variables

$$gdp_{it} = \sum_{j=1}^{p} \alpha_{ij} gdp_{it-j} + \sum_{j=0}^{q} \delta_{ij}' x_{it-j} + \mu_i + \varepsilon_{it}, \qquad (1)$$

with $i = \overline{1,N}$ countries, $t = \overline{1,T}$ periods, gdp the log of real GDP, x_{it} the vector of explanatory variables, namely the log of government expenditure and of tax revenues, μ_i

country-specific fixed effects, and ε_{it} the error term. Since our goal is to evaluate the effect of government spending on output, it is necessary to include taxes as a control variable, as spending are not independent of taxes (Blanchard and Perotti, 2002).[5]

Assuming that variables are I(1) and cointegrated, we reparameterise model (1) into the following error correction model (Pesaran et al., 1999)

$$\Delta gdp_{it} = \phi_i \left(gdp_{it-1} - \beta_i' x_{it}\right) + \sum_{j=1}^{p-1} \alpha_{ij}^* \Delta gdp_{it-j} + \sum_{j=0}^{q-1} \delta_{ij}^{*}{}' \Delta x_{it-j} + \mu_i + \varepsilon_{it}, \quad (2)$$

where $\phi_i = -\left(1 - \sum_{j=1}^{p} \alpha_{ij}\right)$, $\beta_i = \sum_{j=0}^{q} \delta_{ij} / \left(1 - \sum_{k} \alpha_{ik}\right)$, $\alpha_{ij}^* = -\sum_{m=j+1}^{p} \alpha_{im}$, and $\delta_{ij}^* = -\sum_{m=j+1}^{q} \delta_{im}$. The first part of (2)–in levels–captures the long-run relationship, while the second part–in differences–illustrates the short-run adjustment to the long-run equilibrium. Parameter ϕ_i is the error-correcting term and measures the speed of adjustment. To validate the existence of a long-run relationship, this parameter should be negative and significant.

The literature suggests three main approaches for the estimation of model (2): (i) the dynamic fixed effect (DFE) estimator uses pooled data and allows the intercept to differ across groups; however, if the assumption of the common slope fails to hold, then the estimator is inconsistent; (ii) the pooling mean group estimator (PMG) combines both pooling and averaging; it assumes long-run coefficients to be equal across groups, but allows short-run coefficients to differ across groups, and (iii) the mean group (MG) estimator, which allows intercepts, slope coefficients and errors variances to differ across groups (Pesaran and Smith, 1995). In this paper, since we aim at capturing long-term dynamics, we start by using the DFE estimator. Then, we draw upon previous evidence and econometric tests to make the case for the use of the PMG estimator as the most appropriate for our sample of CEEC. Indeed, the use of the PMG estimator will allow assessing the short-run dynamic of countries, while controlling for the long-run relationship between spending and output.

3.4. Building a measure of discretionary expenditure shocks

The main feature of the error correction model (2) is that short-run dynamics of variables are influenced by deviations from the long-run equilibrium. Thus, short-run coefficients capture output's responsiveness to fiscal policy adjustments with respect to the long-run equilibrium.

[5] Prior to the adoption of this specification, we performed several estimations that included inflation, the real exchange rate or the interest rate as control variables. Since the inclusion of these controls does not significantly affect the coefficients of interest, we opted for this more parsimonious specification that has the merit of preserving substantial degrees of freedom, thus limiting the danger of biased estimates (see Pesaran and Smith, 1995).

However, there is no reason to believe that observed variations in fiscal policy are exogenous or unexpected. Thus, to compute output's response to unexpected government spending changes, we follow the methodology of Fatas and Mihov (2003, 2006), Afonso et al. (2010) and Agnello et al. (2013), and construct a measure of discretionary fiscal policy as follows.

Assuming that public spending can be decomposed into a structural (anticipated) and a residual (non-anticipated) component, we define discretionary spending shocks as the cyclically-adjusted component of government spending, which reflects unexpected fiscal policy changes. For each of 11 CEEC in our sample, we estimate the following model using quarterly data over the period 1999q1-2013q3

$$\log(G_{it}) = \alpha_i + \beta_i \log(G_{it-1}) + \gamma_i ogap_{it} + \delta_i debt_{it} + \xi_{it} trend + \varepsilon_{it}, \quad (3)$$

with G total government spending, $ogap$ the output gap (based on the Hodrick-Prescott-filtered log of real GDP), $debt$ the central government debt in % of GDP, and $trend$ the time trend. Consequently, we capture spending shocks through the residuals ε.

Equation (3) differs from the specification of Fatas and Mihov (2003) and Agnello et al. (2013). Indeed, following Blanchard (1993), and closely related Fatas and Mihov (2006), we estimate equation (3) in levels. In addition, compared to Fatas and Mihov (2006) who use GDP growth, we employ the output gap to capture the business cycle, for the following reasons. Output gap has the advantage of controlling for the degree of inflation pressure. Next, it also captures the state of unemployment, because a zero output gap corresponds to full employment. Moreover, a negative output gap suggests the existence of available excess capacities, while the crowding-out of private investment may be independent of the sign of the GDP growth rate. Finally, we control for fiscal policy sustainability and for the persistence of the responsiveness of fiscal policy to the business cycle, using the debt-to-GDP ratio and lagged government spending, respectively.

IV. Fiscal multipliers in CEEC: Main results

4.1. Stationarity and cointegration

To assess the stationarity of our main variables, we report in Table 1 the results of the Fisher-ADF, IPS and LLC unit root tests. We include in the auto-regressive specification of each test both the trend and the intercept, to test for both difference and trend stationarity. As illustrated by Table 1, the log of real GDP, total government expenditure and tax revenues are nonstationary, since, irrespective of the test, we cannot reject the null hypothesis of the presence of a unit root. In addition, as emphasized by low p-values, these variables are stationary in first-difference, once again irrespective of the considered test. Since variables are integrated of the same order, we look in the following for potential cointegration relations among them.

Table 1: Unit root tests

Variables	**ADF**		**IPS**		**LLC**	
	Statistic	p-value	Statistic	p-value	Statistic	p-value
Log(real GDP)	**Z**: 3.78	0.99	**W-T-bar**: 3.61	0.99	**T***: 2.11	0.98
	Pm: -0.21	0.58				
D(Log of real GDP)	**Z**: -3.12	0.00	**W-T-bar**: -3.30	0.00	**T***: -7.20	0.00
	Pm: 6.51	0.00				
Log(Total Government Expenditures)	**Z:** 5.11	1.00	**W-T-bar:** 5.23	1.00	**T***: 0.84	0.80
	Pm: -2.34	0.99				
D(Log(Total Government Expenditures))	**Z**: -2.04	0.02	**W-T-bar**: -2.05	0.01	**T*:**-7.70	0.00
	Pm: 2.13	0.01				
Log(Taxes revenues)	**Z**: 2.56	0.99	**W-T-bar**: 2.18	0.98	**T***: 2.80	0.99
	Pm: -2.19	0.98				
D(Log(Taxes revenues))	**Z**: -9.50	0.00	**W-T-bar**: -14.4	0.00	**T***: -15.93	0.00
	Pm: 19.1	0.00				

Note: Z is the inverse normal statistic, Pm is the modified inverse chi-squared. The null hypothesis is "all panel contain a unit root". The specification includes a trend and an intercept. We use 4 lags following the AIC test.

To assess cointegration, we draw upon Westerlund's (2007) tests. These tests assume the null hypothesis of no cointegration, against four different specifications of the alternative hypothesis: the group mean test and its asymptotic version, which consider the alternative hypothesis that the panel is cointegrated as a whole, and the panel mean test and its asymptotic version, which consider the alternative hypothesis that there is at least one cross-section unit for which the series are cointegrated. To preserve the consistency and the size accuracy in the case of cross-sectional dependence, we carry out the tests using bootstrap with

1000 replications. Table 2 provides the results of testing for a potential cointegration relationship between real GDP, government expenditure and taxes. Irrespective of the considered test, low p-values in Table 2 support the presence of cointegration between variables.

Table 2: Westerlund (2007) cointegration tests

Statistic	Value	Z-value	P-value
Gt	-2.896	-3.100	0.003
Ga	-13.982	-2.568	0.003
Pt	-8.476	-2.706	0.033
Pa	-10.233	-2.591	0.039

Note: Gt and Pt are respectively the group mean test and the panel mean test. Ga and Pa refer to the asymptotic version of the test. The null hypothesis is "no cointegration". We use 3 lags following the AIC test.

Given that series in level are all I(1) and co-integrated, we will draw in the following upon an error correction models to compute output's response to spending shocks.

4.2. Fiscal multipliers in CEEC countries: full sample

To estimate fiscal multipliers, we proceed in three steps. First, we isolate public spending shocks. Table 3 illustrates the results of the OLS estimation of equation (3), for each of the 11 CEEC in our sample.[6] As signalled by positively-significant coefficients of output gap, government expenditure is pro-cyclical in all (but Croatia) CEEC in our sample, consistent with previous evidence on developing and emerging countries (see Dalic, 2013). Furthermore, non significant or positive debt coefficients suggest that the adjustment in response to indebtedness takes place more likely through an adjustment of taxes than of public spending. Finally, irrespective of the considered country, fairly high R2 values support the quality of our specification for purging most of anticipated public spending, and isolate public spending shocks through the country-specific error terms.

[6] Fatas and Mihov (2003) noticed that using OLS or IV in this first-stage regression leads to comparable results. We tested several specifications, in which output gap is generated alternatively using one and three GDP lags, to avoid reverse causality. We report that we did not unveil significant changes in our results (estimations are available upon request).

Table 3: Estimates of the discretionary component of the fiscal policy

Dependent variable: Log(Total Government expenditure)	Bulgaria	Croatia	Czech Republic	Estonia	Hungary	Latvia	Lithuania	Poland	Romania	Slovakia	Slovenia
Log(Total Government expenditure),t-1	0.882***	1.100***	0.740***	0.968***	0.745***	0.857***	0.905***	0.682***	0.526***	0.765***	0.846***
	(0.0999)	(0.0393)	(0.0999)	(0.0476)	(0.0817)	(0.0846)	(0.0848)	(0.0949)	(0.0747)	(0.0932)	(0.0686)
Output gap	1.134**	0.00541	0.541***	0.339**	0.826***	0.327*	0.475**	0.568***	1.464***	0.512**	0.441*
	(0.552)	(0.180)	(0.187)	(0.161)	(0.267)	(0.173)	(0.222)	(0.195)	(0.273)	(0.226)	(0.259)
Real debt of the central government % GDP	0.0192		0.0237*	0.238***	0.0247**	-0.0291	0.0322	-0.0321	0.0609	-5.67e-05	-0.0105
	(0.0116)		(0.0125)	(0.0725)	(0.0106)	(0.0390)	(0.0227)	(0.0199)	(0.0547)	(0.0118)	(0.0133)
Time trend	0.00197	-0.00237***	0.00263*	-0.00114	-0.00207***	0.00122	0.000443	0.00382***	0.00213**	0.00286***	0.000267
	(0.00214)	(0.000546)	(0.00149)	(0.000791)	(0.000685)	(0.00180)	(0.00158)	(0.00134)	(0.000976)	(0.000998)	(0.000366)
Constant	1.878	-1.617**	4.676**	0.541	4.703***	2.318*	1.555	5.991***	8.542***	3.998**	2.662**
	(1.581)	(0.658)	(1.783)	(0.740)	(1.493)	(1.324)	(1.354)	(1.792)	(1.339)	(1.610)	(1.180)
Observations	46	42	50	51	51	51	51	51	43	50	51
Adjusted R-squared	0.969	0.991	0.992	0.988	0.877	0.960	0.981	0.936	0.960	0.980	0.951
F-stat	348.9	1488	1457	1053	89.78	301.8	643.8	183.3	255.0	607.5	245.9

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Debt data is unavailable for Croatia.

Second, we use these recovered shocks as a measure of unanticipated public spending in the estimation of the error correction model. However, drawing upon residuals from another equation in the error correction model may lead to biased estimates. Therefore, we correct standard errors using the Jackknife resampling procedure, which consists of repeatedly computing standard errors, by omitting each time one observation.[7] In our specific case, to take into account both individual and time variability, the statistics are computed leaving out one country.[8]

The first column of Table 4 reports the results of the error correction model used to compute the effects of unanticipated public expenditure on output for the full sample of 11 CEEC, based on the dynamic fixed effect (DFE) estimator with four lags, as suggested by AIC tests. Several points must be highlighted. The error correction term is significant and negative, thus supporting our modelling strategy. Next, the fourth lag of unexpected expenditure is significant, consistent with the tests for the choice of the optimal lag. Finally, our strategy of controlling for tax revenues is supported by their significant coefficients. Based on this model, we compute in the following fiscal multipliers.

[7] Note that performing a standard bootstrap would underestimate time variability in our analysis.

[8] In addition, this procedure allows detecting outliers using Jackknife pseudo-values (Mooney and Duval, 1993). This is a particularly appealing feature, given that the estimator we use is sensitive to outliers especially when the cross-section dimension is weak (Pesaran et al., 1999).

Table 4: Output's response to fiscal policy

	DFE	PMG
Long Run		
Log(Real GDP)		
Error correction term	-0.0386***	-0.0375*
	(0.0121)	(0.0220)
Log(Total Government expenditure)	0.223	0.829***
	(0.326)	(0.0652)
Log(Tax revenues)	0.545**	-0.231***
	(0.262)	(0.0763)
Short Run		
D(Log(Real GDP))		
D(Log(Real GDP),t-1)	0.796***	0.626***
	(0.0543)	(0.0701)
D(Log(Real GDP),t-2)	-0.759***	-0.183*
	(0.0597)	(0.0962)
D(Log(Real GDP),t-3)	0.659***	0.216***
	(0.0684)	(0.0681)
D(Log(Real GDP),t-4)	0.0516	-0.00700
	(0.0575)	(0.0781)
D(Log(Unexpected Government expenditure))	0.0283***	0.0401***
	(0.00759)	(0.0112)
D(Log(Unexpected Government expenditure),t-1)	0.00755	-0.00515
	(0.00906)	(0.00879)
D(Log(Unexpected Government expenditure),t-2)	0.0465***	0.0109
	(0.00820)	(0.00719)
D(Log(Unexpected Government expenditure),t-3)	0.0141	0.0189
	(0.0114)	(0.0119)
D(Log(Unexpected Government expenditure),t-4)	0.0358***	0.0253***
	(0.00447)	(0.00416)
D(Log(Tax revenues))	0.220***	0.221***
	(0.0312)	(0.0283)
D(Log(Tax revenues),t-1)	-0.0589***	-0.00177
	(0.0203)	(0.0219)
D(Log(Tax revenues),t-2)	0.0954***	-0.0101
	(0.0211)	(0.0177)
D(Log(Tax revenues),t-3)	-0.0744***	0.000766
	(0.0197)	(0.0243)
D(Log(Tax revenues),t-4)	-0.0909**	0.00451
	(0.0425)	(0.0292)
Constant	0.219***	0.294*
	(0.0599)	(0.169)
Observations	482	482
Number of countries	11	11
Log Likelihood		1942
Hausman Test p-value		0.1842

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Total government expenditure captures the discretionary component of government spending (the residuals of equation (3)). Standard errors are corrected using the Jackknife procedure. The null hypothesis of the Hausman test is that countries share a common long-run trend. The p-value of this test equals 0.18, thus accepting the null hypothesis and suggesting that the PMG estimator is preferred.

The third and last step consists of computing fiscal multipliers. Following the related literature, we focus on two multipliers. On the one hand, we compute the impact multiplier as $\mu^0 = \frac{\Delta Y_t}{\Delta G_t} = \frac{m_0}{\overline{(G/Y)}}$, with $m_0 = \frac{\Delta\, gdp_t}{\Delta\, exp_t}$ the derivative of the log of GDP with respect to the log of expenditure, and $\overline{(G/Y)}$ the average expenditure-to-GDP ratio. On the other hand, we compute the cumulative multiplier over four quarters (1 year) as $\mu^4 = \frac{M_4}{\overline{(G/Y)}}$, with $M_4 = \sum_{k=0}^{4} m_k$ and $m_k = \frac{\Delta\, gdp_t}{\Delta\, exp_{t-k}}$.

For the full sample model, $m_0 = 0.0283$ (see Table 4) and $\overline{(G/Y)} = 0.4280$ (see Table A.2a in the Appendix), leading to an impact multiplier equal to 0.07. Since the multiplier is significant (see Table 5), we find that, in other words, an increase of 1 unit in government expenditure increases GDP by 0.07 units. In addition, to account for a possible delay in output's response to the fiscal stimulus, we compute the cumulative multiplier. Given that $M_4 = 0.1323$ (see Table 4), the one-year cumulative multipliers equals 0.31 (and is significant, see Table 5). These findings call for two remarks.

First, although spending multipliers are positive and significant, their magnitude is weak. As such our results for emerging CEEC are consistent with previous studies emphasizing fairly small multipliers in developing countries.

Second, note that these values are based on the DFE estimator. However, this estimator rests on the assumption that all CEEC in our sample share a common long-term path and a common short-run dynamic. Regarding the latter, there are several reasons making the assumption of a common short-run dynamic unrealistic. Indeed, for example, given that some CEEC in our sample integrated the EU in 2004, others in 2007, and other did not integrate the EU yet, and the fact that our sample mixes CEEC that adopted the euro with CEEC that did not, we allow in the following for different short-run dynamics for the CEEC in our sample. Regarding the former assumption, we draw upon the Hausman Chi-2 test, which tests the null hypothesis of a common long-term coefficient against the alternative of different coefficients. Based on the associated p-value equal to 0.18 (see the bottom of Table 4), we accept the null hypothesis of a common long-term path for the CEEC in our sample. Consequently, in the following, our baseline specification assumes a common long-term path and different short-run dynamics, by using the Pooled Mean Group (PMG) estimator.

PMG-based estimated impact and cumulative multipliers equal 0.09 and 0.21, respectively, and are significant. Thus, accounting for different short-run dynamics slightly increases output's response on impact, but decreases it by roughly one-third cumulated for four quarters. In what follows, we draw upon PMG estimators to compute country-specific fiscal multipliers.

Table 5: Impact and cumulative fiscal multipliers for the full sample

	Dynamic Fixed Effects (DFE)		Pooling Mean Group (PMG)	
Multiplier	Value	Std Dev	Value	Std Dev
Impact	0.07***	0.01	0.09***	0.02
Cumulative	0.31***	0.07	0.21**	0.07

Note: *** p<0.01, ** p<0.05, * p<0.1.

4.3. Fiscal multipliers in CEEC: country-evidence

One of the key contributions of this paper is to provide both full sample (aggregate) and country estimates of the fiscal multiplier within a unique framework. Based on PMG estimations of the effect of public expenditure on output (see Table 6), Table 7 reports fiscal multipliers for each of the 11 CEEC in our sample (Table A.2a in the Appendix presents country-specific descriptive statistics for public expenditure).

Table 6: Pooling Mean Group (PMG) country-estimates of the effect of public spending on output

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	Short run coefficient by country											**LR**
Dependent variable: GDP per capita growth	Bulgaria	Croatia	Czech R.	Estonia	Hungary	Latvia	Lithuania	Poland	Romania	Slovakia	Slovenia	
Log(Real GDP)												
Log(Total Government Expenditure)												0.813***
												(0.0702)
Log(Tax revenues)												-0.221***
												(0.0823)
Error correction term	-0.119***	-0.0940***	0.000599	-0.0227**	-0.0578**	-0.0243*	-0.0578***	-0.0279*	-0.176***	-0.00662	-0.0508**	
	(0.0368)	(0.0240)	(0.00480)	(0.00900)	(0.0247)	(0.0135)	(0.0131)	(0.0145)	(0.0396)	(0.00915)	(0.0219)	
D(Log(Real GDP))												
D(Log(Real GDP),t-1)	0.725***	0.264*	1.023***	0.403**	0.879***	0.765***	0.505***	0.646***	0.491***	0.925***	0.471***	
	(0.137)	(0.139)	(0.153)	(0.160)	(0.144)	(0.146)	(0.123)	(0.155)	(0.128)	(0.152)	(0.107)	
D(Log(Real GDP),t-2)	-0.575***	-0.0670	-0.417	0.317*	-0.364*	-0.232	0.0587	-0.0642	-0.542***	-0.546***	-0.160	
	(0.189)	(0.135)	(0.254)	(0.188)	(0.194)	(0.156)	(0.148)	(0.205)	(0.164)	(0.181)	(0.115)	
D(Log(Real GDP),t-3)	0.640***	0.242**	0.391	-0.0865	0.334*	0.358**	-0.0993	0.209	0.227	0.505***	0.124	
	(0.177)	(0.119)	(0.241)	(0.180)	(0.193)	(0.157)	(0.148)	(0.183)	(0.204)	(0.191)	(0.115)	
D(Log(Real GDP),t-4)	0.365*	-0.257***	-0.0208	-0.175	-0.226*	-0.290**	0.00684	-0.181	0.399***	-0.169	0.387***	
	(0.200)	(0.0843)	(0.143)	(0.140)	(0.134)	(0.121)	(0.130)	(0.127)	(0.152)	(0.153)	(0.0986)	
D(Log(Unexpected Government Expenditure))	0.00652	0.0598***	0.0975***	0.0465***	0.0249	0.0122	0.0619***	0.0470***	-0.0214	0.0384	0.0818***	
	(0.0153)	(0.0102)	(0.0264)	(0.0113)	(0.0169)	(0.0129)	(0.0146)	(0.0112)	(0.0181)	(0.0239)	(0.0151)	
D(Log(unexpected Government expenditure),t-1)	0.0159	-0.0172	0.0130	0.0201	-0.0152	-0.0285**	0.0174	0.0133	-0.0726***	-0.0553***	0.00515	
	(0.0157)	(0.0129)	(0.0287)	(0.0129)	(0.0167)	(0.0124)	(0.0182)	(0.0148)	(0.0182)	(0.0202)	(0.0179)	
D(Log(Unexpected Government expenditure),t-2)	0.0211	-0.00433	0.0945***	-0.000310	0.0137	-0.0103	-0.0103	0.0441***	0.00902	0.0488**	7.50e-05	
	(0.0139)	(0.0163)	(0.0248)	(0.0121)	(0.0190)	(0.0127)	(0.0170)	(0.0154)	(0.0222)	(0.0241)	(0.0180)	
D(Log(Unexpected Government expenditure),t-3)	0.0170	-0.0428***	0.0832***	0.0508***	0.0115	-0.0200*	0.0432***	0.00540	-0.0276	-0.0104	0.0433**	
	(0.0115)	(0.0154)	(0.0248)	(0.00904)	(0.0158)	(0.0119)	(0.0160)	(0.0130)	(0.0226)	(0.0214)	(0.0177)	
D(Log(Unexpected Government expenditure),t-4)	0.0292***	0.0153	0.0436*	0.0371***	0.0172	0.0428***	0.0367***	0.0432***	0.0163	0.0326	-0.00970	
	(0.00973)	(0.0132)	(0.0247)	(0.0111)	(0.0190)	(0.0120)	(0.0109)	(0.0127)	(0.0185)	(0.0214)	(0.0145)	
D(Log(Tax revenues))	0.122***	0.350***	0.0890**	0.173***	0.247***	0.229***	0.242***	0.241***	0.366***	0.124**	0.244***	
	(0.0467)	(0.0361)	(0.0415)	(0.0300)	(0.0744)	(0.0387)	(0.0539)	(0.0491)	(0.0701)	(0.0485)	(0.0453)	
D(Log(Tax revenues),t-1)	-0.145**	0.133**	9.90e-05	-0.0639	-0.0400	-0.0176	0.0913	0.0267	0.0356	-0.0382	0.0644	
	(0.0610)	(0.0618)	(0.0463)	(0.0403)	(0.0777)	(0.0494)	(0.0612)	(0.0608)	(0.0909)	(0.0521)	(0.0418)	
D(Log(Tax revenues),t-2)	0.0921	-0.0435	-0.0671	0.0392	-0.0614	0.0732	-0.00154	-0.0823	-0.0295	0.00764	-0.0358	
	(0.0723)	(0.0592)	(0.0507)	(0.0451)	(0.0818)	(0.0470)	(0.0605)	(0.0579)	(0.0596)	(0.0589)	(0.0401)	
D(Log(Tax revenues),t-3)	-0.0866	0.151***	-0.0439	0.131***	-0.0642	-0.0135	-0.110*	-0.0234	0.0492	-0.00398	0.0440	
	(0.0710)	(0.0470)	(0.0490)	(0.0420)	(0.0798)	(0.0464)	(0.0588)	(0.0562)	(0.0534)	(0.0532)	(0.0395)	
D(Log(Tax revenues),t-4)	0.000854	0.136***	-0.0807*	0.0989**	0.107	-0.0399	0.0365	0.0160	-0.127**	0.0669	-0.178***	
	(0.0542)	(0.0490)	(0.0475)	(0.0386)	(0.0771)	(0.0457)	(0.0650)	(0.0520)	(0.0612)	(0.0560)	(0.0369)	
Constant	-0.899***	0.731***	-0.00248	0.161**	0.465**	0.177*	0.434***	0.241*	1.412***	0.0538	0.387**	
	(0.272)	(0.182)	(0.0383)	(0.0630)	(0.198)	(0.0975)	(0.0960)	(0.124)	(0.295)	(0.0696)	(0.169)	
Observations							482					
Log likelihood							1939					
Number of countries							11					

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Total government expenditure captures the discretionary component of government spending.

Table 7a: Fiscal multipliers by country (PMG estimator)

Multiplier	Impact	Std dev	Cumulative	Std dev
Bulgaria	0.02	0.03	0.07	0.10
Croatia	0.13***	0.02	0.07	0.10
Czech Republic	0.21***	0.04	0.68***	0.16
Estonia	0.10***	0.02	0.29***	0.05
Hungary	0.06*	0.04	0.07	0.13
Latvia	0.03	0.03	-0.01	0.09
Lithuania	0.15***	0.03	0.34**	0.11
Poland	0.12**	0.03	0.35**	0.11
Romania	-0.05*	0.03	-0.18**	0.08
Slovakia	0.09**	0.04	-0.01	0.10
Slovenia	0.19***	0.03	0.29**	0.09

Note: *** p<0.01, ** p<0.05, * p<0.1.

Analogous to estimations for the pooled sample, we present results for both impact and cumulative multipliers. Let us discuss impact multipliers. First, regarding sign differences, although most multipliers are positive, we equally reveal statistically not significant multipliers (for example, in Bulgaria or Latvia), and even a negative impact multiplier in Romania (albeit weakly significant). Second, we emphasize magnitude differences across multipliers in CEEC: for example, the impact multiplier in Czech Republic and Slovenia is roughly four times higher compared to Romania (in absolute value), and roughly two times higher if we stick to significant positive multipliers, for example in Estonia and Poland.

Such sign and magnitude heterogeneities equally arise if we consider the cumulated response of GDP to fiscal shocks after four quarters. On the one hand, cumulative multipliers are positive in most countries, and remain non significant in Bulgaria or Hungary. However, we now find negative multipliers in three out of the eleven countries of our sample, namely Latvia, Romania and Slovakia. On the other hand, the magnitude of cumulative multipliers is stronger compared to impact multipliers; for example, the multiplier is around 0.3 in four countries (Estonia, Lithuania, Poland and Slovenia), and even as high as 0.7 in Czech Republic.

These results call for two remarks. On the one hand, recall that multipliers were computed based on a model that assumed a common long-term path and different short-run dynamics among CEEC. If the fact of not accounting for the long-term path (for example, like in PVAR models) is an obvious drawback, we can illustrate the differences induced by not accounting for a common trend by comparing our results with mean group (MG) estimates, which assume different long-term paths (in addition to different short-run dynamics) among CEEC (see Table A.5 in the Appendix for MG estimated coefficients).

Table 7b: Fiscal multipliers by country (MG estimator)

Multiplier	Impact	Std dev	Cumulative	Std dev
Bulgaria	-0.04	0.04	0.07	0.12
Croatia	0.13***	0.03	0.02	0.16
Czech Republic	0.05	0.06	-0.05	0.26
Estonia	0.10**	0.03	0.32***	0.07
Hungary	0.02	0.05	0.01	0.19
Latvia	0.11**	0.04	0.41**	0.18
Lithuania	0.17***	0.04	0.55**	0.18
Poland	0.11**	0.04	0.31**	0.15
Romania	-0.01	0.05	0.06	0.15
Slovakia	0.02	0.06	0.03	0.15
Slovenia	0.15**	0.04	0.26**	0.13

Note: *** p<0.01, ** p<0.05, * p<0.1.

Compared to Table 7a, Table 7b emphasizes significant difference for both impact and cumulative multipliers. Focusing on impact multipliers, not accounting for a common long-term path would (i) overestimate their significance in Latvia and underestimate it in Czech Republic, Slovakia, and, to some extent, in Romania, and (ii) overestimate their size in Latvia and underestimate it in Czech Republic and Slovakia. These differences are reinforced regarding cumulative multipliers. For example, not accounting for a common long-term path would (i) overestimate their significance in Latvia and underestimate it in Czech Republic, Romania and Slovakia, and (ii) overestimate their size in Latvia and Lithuania, and underestimate it in Czech Republic and in Romania (particularly for Romania, the estimated coefficient would be positive, instead of significantly negative).

On the other hand, country-evidence unveils important short-run heterogeneities across CEEC. Consistent with the standard ISLM model, we emphasize Keynesian effects of fiscal policy both on impact and after one year, in most of CEEC in our sample. However, in several countries we do not find significant multipliers, neither on impact (for example, in Bulgaria and Hungary), nor cumulated after four quarters (for example, in Bulgaria and Latvia), in line with the Ricardian Equivalence Theorem of Barro (1974). In addition, we even find anti-Keynesian effects of fiscal policy on output, in the form of negative multipliers (for example, in Romania on impact, and in Latvia, Romania and Slovakia cumulated after four quarters). Thus, even if CEEC are expected to converge in the long-run towards a common steady-state, the dynamic of their output following fiscal shocks might be quite different. This calls for a closer look at specificities at work in CEEC.

V. Fiscal multipliers in CEEC: Conditionality upon structural characteristics

Heterogeneities in output's response to fiscal policy unveiled in the previous section are probably related to economic and structural differences among CEEC. In the following, we analyze the sensitivity of multipliers to such differences.

We consider four structural characteristics of CEEC. First, we seize differences in monetary policy by considering alternatively countries with fixed (pegged), intermediate and flexible exchange rate regime (ERR), using the classification of Ilzetzki et al. (2010) reported in Table A.3 in the Appendix. Second, to account for the level of economic development, we divide CEEC using the level of income (average over 1999:q1-2013:q3), into low- and high-income CEEC, respectively. Third, we capture the fiscal stance using the public debt[9] to distinguish among low-debt CEEC (with a debt ratio of 22% of GDP on average over 1999:q1-2013:q3) and high-debt CEEC (with an average debt ratio of 48% of GDP for the same period).[10] Finally, we take into account the openness degree using the level of exports in percentage of GDP, and, accordingly, we divide CEEC into countries with relatively low and high openness degree, respectively. Table 8 presents the countries in each group.

Table 8: List of groups of countries based on CEEC' structural characteristics

	Exchange Rate Regime (ERR)			**Level of income**		**Public Debt (%GDP)**		**Openness degree (%GDP)**	
	Pegged	**Intermediate**	**Floating**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Group mean	**-**	**-**	**-**	**5.25e+07**	**2.84e+08**	**22.42**	**48.29**	**45.11**	**69.25**
	Bulgaria	Croatia	Poland	Bulgaria	Czech R.	Czech R.	Bulgaria	Bulgaria	Czech R.
	Estonia	Czech R.	Romania	Croatia	Hungary	Estonia	Croatia	Croatia	Estonia
	Lithuania	Hungary		Estonia	Poland	Latvia	Hungary	Latvia	Hungary
	Slovenia	Latvia		Latvia	Romania	Lithuania	Poland	Lithuania	Slovakia
		Slovakia		Lithuania	Slovakia	Romania	Slovakia	Poland	Slovenia
		Slovenia		Slovenia		Slovenia		Romania	

Based on Table 8, Table 9 presents the estimations of the effect of unexpected government spending on output using the PMG estimator,[11] and Table 10 reports the associated multipliers (Table A.2b in the Appendix presents descriptive statistics for each group of countries).

[9] We use the gross consolidated debt of the central government (the same measures is used, for example, by Ilzetzki et al., 2013).

[10] We split countries based on the median public debt to GDP ratio for the sample period 1999:q1-2013:q3. Considering median public debt, instead of an exogenous threshold of 60% (as suggested by the Maastricht Treaty), is justified by the fact that in our sample only Hungary presents a debt ratio above this threshold.

[11] Since the lag structure changes across structural characteristics, and due to the loses in degrees of freedom, we set the number of lags equal to 4 (the same is done by Ilzetzki et al., 2013, in their analysis based on quarterly data).

Table 9: PMG estimates of the effect of unexpected government spending on output when accounting for CEEC' structural characteristics

	Full model	Exchange Rate Regime (ERR)			Level of income		Public debt (% of GDP)		Openness degree	
		Pegged	**Intermediate**	**Floating**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Long Run										
Log(Real GDP)										
Error correction term	-0.0375*	-0.0121	-0.182**	0.0452	-0.0260	-0.170***	-0.0766	-0.0905**	0.0101	-0.125
	(0.0220)	(0.0414)	(0.0751)	(0.0769)	(0.0328)	(0.0551)	(0.0845)	(0.0418)	(0.00907)	(0.0777)
Log(Total Government Expenditure)	0.829***	1.146***	0.772***	0.809***	0.899***	0.130***	0.677***	0.281***	2.779	0.581***
	(0.0652)	(0.107)	(0.0314)	(0.114)	(0.0559)	(0.0502)	(0.0373)	(0.0918)	(1.827)	(0.0615)
Log(Tax revenues)	-0.231***	-0.517***	0.272***	0.258**	-0.289***	0.736***	0.332***	0.611***	-1.872	0.405***
	(0.0763)	(0.110)	(0.0235)	(0.123)	(0.0670)	(0.0456)	(0.0293)	(0.0961)	(1.975)	(0.0470)
Short Run										
Control for Real GDP (up until the lag 4)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
D(Log(Unexpected Government Expenditure))	0.0401***	0.0510***	0.0347**	0.0541***	0.0479***	0.0245*	0.0481***	0.0260**	0.0400***	0.0363**
	(0.0112)	(0.0197)	(0.0136)	(0.0202)	(0.0122)	(0.0137)	(0.0107)	(0.0106)	(0.0131)	(0.0144)
D(Log(Unexpected Government Expenditure),t-1)	-0.00515	0.0139***	-0.0103	0.0203	0.00183	-0.0214	-0.00226	-0.00592	-0.00339	-0.0184
	(0.00879)	(0.00482)	(0.0142)	(0.0149)	(0.00754)	(0.0162)	(0.0122)	(0.0123)	(0.00908)	(0.0156)
D(Log(Unexpected Government Expenditure),t-2)	0.0109	0.00610	0.0195	0.0378***	0.00169	0.0134***	0.0101	0.00648	0.00870	-0.00211
	(0.00719)	(0.00854)	(0.0244)	(0.0143)	(0.00664)	(0.00171)	(0.00785)	(0.00701)	(0.00965)	(0.00627)
D(Log(Unexpected Government Expenditure),t-3)	0.0189	0.0390***	0.0166	0.0329***	0.0175	0.0176*	0.0377***	-0.00325	0.00266	0.0313***
	(0.0119)	(0.0100)	(0.0210)	(0.00918)	(0.0144)	(0.00903)	(0.0107)	(0.0156)	(0.0134)	(0.00943)
D(Log(Unexpected Government Expenditure),t-4)	0.0253***	0.0290***	0.0329*	0.0388	0.0271***	0.0147*	0.0307***	0.0214***	0.0347***	0.0119
	(0.00416)	(0.00990)	(0.0195)	(0.0276)	(0.00690)	(0.00780)	(0.00980)	(0.00314)	(0.00532)	(0.00933)
Control for Taxes (up until the lag 4) and for the Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	482	179	237	77	262	220	267	215	254	228
Number of countries	11	4	7	2	6	5	6	5	6	5
Log Likelihood	1942	752.0	1028	286.4	1116	843.3	1098	851.6	996.4	931.0

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Total government expenditure captures the discretionary component of government spending (the residuals of equation (3)). Standard errors are corrected using the Jackknife resampling procedure. We control for Real GDP and for Taxes up until the lag 4 (the full table is reported in Appendix as Table A.4).

Table 10: Fiscal multipliers when accounting for CEEC' structural characteristics (PMG)

Multiplier	Impact	Std dev	Cumulative	Std dev
Full model	0.09***	0.02	0.21**	0.07
Exchange Rate Regime				
Pegged	0.11**	0.04	0.32***	0.05
Intermediate	0.07**	0.03	0.20	0.15
Floating	0.13**	0.05	0.46***	0.04
Level of Economic Development				
Low income	0.11***	0.02	0.22**	0.06
High income	0.05	0.03	0.11	0.07
Level of Debt-to-GDP Ratio				
Low debt	0.10***	0.02	0.28***	0.07
High debt	0.06**	0.02	0.10	0.06
Openness Degree				
Low openness	0.11***	0.02	0.26**	0.07
High openness	0.08**	0.03	0.13	0.09

Note: *** p<0.01, ** p<0.05, * p<0.1.

Let us first focus on the type of the exchange rate regime. As shown by Table 10, the ERR does not seem to matter for the impact response of output to changes in fiscal policy: impact multipliers equal 0.11, 0.07 and 0.13, respectively. On the contrary, cumulative multipliers are highly sensitive to the ERR. For example, on the one hand, the cumulated response of output is 0.32 for pegged ERR, compared to statistically 0 (i.e. not significant) for intermediate ERR, consistent with the Mundell-Fleming model and previous evidence of more effective fiscal stimulus under pegged regimes in developed countries (Born et al., 2013). On the other hand, the cumulated fiscal multiplier for floating ERR equals 0.46, and is equally higher than for intermediate ERR, consistent yet again with evidence for developed countries (Monacelli and Perotti, 2010, Ramey, 2011).[12] These results asserting that corner (namely, pegged and flexible) ERR perform better than intermediate ERR when it comes to fiscal multipliers seem to suggest that the weak credibility of intermediate ERR in CEEC in our sample reduces the efficiency of fiscal policy.

Second, using median income as cut-off, Table 10 shows that the multiplier is sensitive to the level of economic development. Specifically, both impact and cumulative multipliers are significant only in low-income, relative to high-income CEEC. Thus, our findings suggest the presence of growth-effects of fiscal policies in less developed CEEC.

[12] Albeit inconsistent with the predictions of the Mundell-Fleming model, this result meets some recent findings in the literature on developed countries; for example, Corsetti et al. (2012) explain that an expansionary fiscal policy can be associated with a real depreciation of the currency, thus boosting economic activity. For a recent discussion of heterogeneities related to the exchange rate regime in CEEC, see Josifidis et al. (2013).

Third, to account for a potential role of the fiscal stance, we compute multipliers for CEEC with relatively low and high debt-to-GDP ratios, respectively. Result in Table 10 display impact multipliers of 0.10 and 0.06, and cumulative multipliers of 0.28 and statistically 0 for CEEC with low and high debt, respectively. Thus, our findings mirror the recent literature emphasizing nonlinear effects of fiscal policy on economic growth in a context of relatively high public debt,[13] and defend sound macroeconomic environments (and particularly, low debt) as a tool for reinforcing the efficiency of fiscal-policy-based measures for supporting economic growth.

Finally, we use the level of exports in percentage of GDP to divide CEEC between countries with low and high openness degree, respectively. As this was the case for the ERR, the openness degree is not found to influence the effects of fiscal policy on impact. On the contrary, cumulative multipliers are significant only in relatively less open CEEC (0.26, against statistically 0 in relatively more open CEEC), consistent with the predictions of the conventional Mundell-Fleming model.

VI. Conclusion

Despite an impressive strand of literature estimating fiscal multipliers in developed countries, evidence for developing and emerging countries remains remarkably scarce. This paper provides new insights into how fiscal stimulus affects the output in 11 emerging Central and Eastern European Countries, based on a rather different methodological approach. Indeed, if most studies draw upon VAR models, we use a Panel Vector Error Correction model, selected for its particularly appealing features when it comes to CEEC: on the one hand, it allows accounting for their common long-run path, supported by their integration in the E(M)U, and, on the other hand, it permits computing different short-run dynamics in an integrated framework that controls for their common long-run path. In addition, we pay special attention to identifying truly exogenous shocks, through implementing an econometric procedure together with using genuine quarterly data.

Estimations performed over the period 1999q1-2013q3 unveil the following results. First, fiscal multipliers are positive and significant for CEEC, albeit with important differences between impact and four-quarter cumulative multipliers. Second, country-specific multipliers are heterogeneous across CEEC, in sign, significance, and magnitude. Third,

[13] Such nonlinear effects of fiscal policy on growth in high-debt contexts are emphasized by Minea & Parent (2012) and Egert (2015) in developed countries, and by Eberhardt & Presbitero (2013) and Kourtellos et al. (2013) in developing countries. In addition, fiscal multipliers were also find to decline in developed countries, but above higher debt thresholds, namely 60% (Ilzetzki et al., 2013) or 100% (Corsetti et al., 2012).

impact and cumulative fiscal multipliers are strongly sensitive to CEEC' characteristics. In particular, we find significant multipliers in CEEC with fixed or floating ERR, in less developed CEEC, in the CEEC with relatively low public debt-to-GDP ratios, and in relatively less open CEEC.

These results have important policy implications. On the one hand, our findings suggest that a strategy for improving the growth effects for fiscal policy in small open CEEC is to move towards extreme ERR. This is a particularly appealing finding, since some CEEC already integrated the euro zone, and the remaining should perform structural reforms that would allow them to join the euro zone in the future, including more fixity in their exchange rate arrangements. On the other hand, conditionally upon a sound fiscal stance, our paper makes the case for fiscal policies as a device for supporting economic growth in less developed CEEC, thus improving the convergence process among them.

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APPENDIX
(TO BE PUBLISHED EXCLUSIVELY AS ELECTRONIC SUPPLEMENTARY MATERIAL)

Table A.1a: List of countries

Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia

Table A.1b: Descriptive statistics

Variables	Observations	Mean	Standard Dev	Min	Max
Real GDP	482	1.59e+08	1.78e+08	1.68e+07	8.76e+08
Government expenditure	482	6.75e+07	7.19e+07	7246924	4.21e+08
Tax revenues	482	1.91e+07	2.25e+07	1757586	1.16e+08
Real exchange rate	482	101.3819	11.21874	69.44	135.55
Central government debt (% GDP)	429	29.68998	18.11024	1	81
Export of goods & services (% GDP)	482	55.67858	16.1442	23.62175	89.89667

Table A.2a: Summary statistics of government expenditure in % of GDP (by country)

	Mean	Std Dev
Full model	42.79962	6.02706
Bulgaria	39.34807	7.50139
Croatia	44.42253	3.09011
Czech Republic	46.89297	3.09541
Estonia	47.13088	4.45549
Hungary	43.43218	5.52663
Latvia	44.40612	6.04969
Lithuania	41.18482	4.95491
Poland	38.35802	5.01909
Romania	39.54567	5.12169
Slovakia	44.36725	7.31942
Slovenia	42.85272	2.58801

Table A.2b: Summary statistics of government expenditure in % of GDP (by category)

	Mean	Std Dev
Full model	42.79962	6.02706
Pegged regime	42.82518	5.972292
Intermediate regime	45.07149	5.150866
Floating regime	39.68591	4.971359
Low income	42.77994	5.701126
High Income	42.82263	6.395615
Low Debt	43.80545	5.278542
High Debt	42.79962	6.02706
Low Openness	40.65295	5.876038
High Openness	45.20631	5.239712

Table A.3: CEEC' ERR classification based on Ilzetzki, Reinhart and Rogoff (2010)

Code	Fine classification	Coarse classification	Countries
1	No separate legal tender		Bulgaria, Estonia
2	Pre announced peg or currency board	Pegged	Lithuania, Slovenia
4	De facto Peg		
8	De facto crawling band that is narrowed than or equal to+/-2%		Croatia, Czech Republic
9	Pre announced crawling band that is wider than or equal to +/-2%		Hungary, Latvia
10	De facto crawling band that is narrower than or equal to +/-5%	Intermediate	Slovakia
11	Moving band that is narrower than or equal to +/-2%		Slovenia
	(i.e., allows for both appreciation and depreciation over time)		
12	Managed floating	Floating	Poland, Romania
14	Freely falling		
15	Dual market in which parallel market data is missing.	Other	

Table A.4: PMG estimates of the effect of unexpected government spending on output when accounting for CEEC' structural characteristics (full Table 9)

	Full model	Exchange Rate Regime (ERR)			Level of income		Public debt (% of GDP)		Openness degree	
		Pegged	**Intermediate**	**Floating**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Long Run										
Log(Real GDP)										
Error correction term	-0.0375*	-0.0121	-0.182**	0.0452	-0.0260	-0.170***	-0.0766	-0.0905**	0.0101	-0.125
	(0.0220)	(0.0414)	(0.0751)	(0.0769)	(0.0328)	(0.0551)	(0.0845)	(0.0418)	(0.00907)	(0.0777)
Log(Total Government Expenditure)	0.829***	1.146***	0.772***	0.809***	0.899***	0.130***	0.677***	0.281***	2.779	0.581***
	(0.0652)	(0.107)	(0.0314)	(0.114)	(0.0559)	(0.0502)	(0.0373)	(0.0918)	(1.827)	(0.0615)
Log(Tax revenues)	-0.231***	-0.517***	0.272***	0.258**	-0.289***	0.736***	0.332***	0.611***	-1.872	0.405***
	(0.0763)	(0.110)	(0.0235)	(0.123)	(0.0670)	(0.0456)	(0.0293)	(0.0961)	(1.975)	(0.0470)
Short Run										
D(Log(Real GDP))										
D(Log(Real GDP),t-1)	0.626***	0.506***	0.614***	0.603***	0.524***	0.751***	0.619***	0.628***	0.668***	0.691***
	(0.0701)	(0.0671)	(0.0859)	(0.0298)	(0.0736)	(0.104)	(0.0685)	(0.123)	(0.0426)	(0.0978)
D(Log(Real GDP),t-2)	-0.183*	-0.0701	-0.217**	-0.0848	-0.0811	-0.228	-0.114	-0.248	-0.179	-0.169
	(0.0962)	(0.207)	(0.0924)	(0.341)	(0.128)	(0.147)	(0.128)	(0.202)	(0.180)	(0.132)
D(Log(Real GDP),t-3)	0.216***	0.0873	0.306***	0.179	0.148	0.296***	0.136*	0.430***	0.310***	0.174**
	(0.0681)	(0.161)	(0.0762)	(0.140)	(0.113)	(0.0360)	(0.0807)	(0.103)	(0.108)	(0.0880)
D(Log(Real GDP),t-4)	-0.00700	0.162	-0.0195	0.221	0.0290	0.0589	0.144	-0.125**	0.00320	0.0446
	(0.0781)	(0.168)	(0.160)	(0.381)	(0.132)	(0.102)	(0.124)	(0.0511)	(0.134)	(0.108)
D(Log(Unexpected Government Expenditure))	0.0401***	0.0510***	0.0347**	0.0541***	0.0479***	0.0245*	0.0481***	0.0260**	0.0400***	0.0363**
	(0.0112)	(0.0197)	(0.0136)	(0.0202)	(0.0122)	(0.0137)	(0.0107)	(0.0106)	(0.0131)	(0.0144)
D(Log(Unexpected Government Expenditure),t-1)	-0.00515	0.0139***	-0.0103	0.0203	0.00183	-0.0214	-0.00226	-0.00592	-0.00339	-0.0184
	(0.00879)	(0.00482)	(0.0142)	(0.0149)	(0.00754)	(0.0162)	(0.0122)	(0.0123)	(0.00908)	(0.0156)
D(Log(Unexpected Government Expenditure),t-2)	0.0109	0.00610	0.0195	0.0378***	0.00169	0.0134***	0.0101	0.00648	0.00870	-0.00211
	(0.00719)	(0.00854)	(0.0244)	(0.0143)	(0.00664)	(0.00171)	(0.00785)	(0.00701)	(0.00965)	(0.00627)
D(Log(Unexpected Government Expenditure),t-3)	0.0189	0.0390***	0.0166	0.0329***	0.0175	0.0176*	0.0377***	-0.00325	0.00266	0.0313***
	(0.0119)	(0.0100)	(0.0210)	(0.00918)	(0.0144)	(0.00903)	(0.0107)	(0.0156)	(0.0134)	(0.00943)

D(Log(Unexpected Government Expenditure),t-4)	0.0253***	0.0290***	0.0329*	0.0388	0.0271***	0.0147*	0.0307***	0.0214***	0.0347***	0.0119
	(0.00416)	(0.00990)	(0.0195)	(0.0276)	(0.00690)	(0.00780)	(0.00980)	(0.00314)	(0.00532)	(0.00933)
D(Log(Tax revenues))	0.221***	0.178***	0.181***	0.279***	0.218***	0.142***	0.188***	0.208***	0.253***	0.145***
	(0.0283)	(0.0341)	(0.0532)	(0.0224)	(0.0323)	(0.0217)	(0.0456)	(0.0428)	(0.0311)	(0.0347)
D(Log(Tax revenues),t-1)	-0.00177	-0.0106	-0.0416	-0.000159	0.00391	-0.0586***	-0.0204	-0.0311	-0.0356	-0.0407
	(0.0219)	(0.0549)	(0.0289)	(0.0497)	(0.0391)	(0.0103)	(0.0235)	(0.0384)	(0.0217)	(0.0254)
D(Log(Tax revenues),t-2)	-0.0101	0.0226*	-0.0831**	-0.00679	0.0190	-0.0998***	-0.0160	-0.0430	-0.0214	-0.0447
	(0.0177)	(0.0127)	(0.0360)	(0.0557)	(0.0200)	(0.0275)	(0.0318)	(0.0510)	(0.0439)	(0.0353)
D(Log(Tax revenues),t-3)	0.000766	0.0103	-0.0371	-0.0580***	0.0292	-0.105***	-0.0261	-0.0594	-0.0505	-0.0139
	(0.0243)	(0.0570)	(0.0456)	(0.0106)	(0.0416)	(0.0220)	(0.0421)	(0.0438)	(0.0328)	(0.0402)
D(Log(Tax revenues),t-4)	0.00451	-0.0291	-0.0670	-0.0985	-0.00281	-0.0760	-0.105***	0.0239	-0.0304	-0.0474
	(0.0292)	(0.0537)	(0.0679)	(0.114)	(0.0428)	(0.0564)	(0.0392)	(0.0317)	(0.0461)	(0.0641)
Constant	0.294*	0.0744	0.0771**		0.187	0.737***	0.0901	0.326**	0.358	0.208
	(0.169)	(0.272)	(0.0314)		(0.238)	(0.238)	(0.0984)	(0.153)	(0.314)	(0.131)
Observations	482	179	237	77	262	220	267	215	254	228
Number of countries	11	4	7	2	6	5	6	5	6	5
Log Likelihood	1942	752.0	1028	286.4	1116	843.3	1098	851.6	996.4	931.0

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Total government expenditure captures the discretionary component of government spending (the residuals of equation (3)). Standard errors are corrected using the Jackknife resampling procedure.

Table A.5: MG country-estimates of the effect of public spending on output

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Short run coefficient by country										
Dependent variable: GDP per capita growth	Bulgaria	Croatia	Czech R.	Estonia	Hungary	Latvia	Lithuania	Poland	Romania	Slovakia	Slovenia
Log(Real GDP)											
Log(Total Government Expenditures)	6.860	0.937***	0.620***	0.599	0.280**	-0.876**	0.722***	0.270**	-0.175	0.794***	0.805***
	(20.72)	(0.327)	(0.0785)	(0.520)	(0.125)	(0.420)	(0.165)	(0.132)	(0.307)	(0.243)	(0.236)
Log(Taxes revenues)	-5.958	-0.467	0.375***	0.208	0.821***	2.487***	0.263	0.614***	1.044***	0.476**	-0.878***
	(19.73)	(0.689)	(0.0602)	(0.582)	(0.133)	(0.587)	(0.285)	(0.139)	(0.367)	(0.224)	(0.257)
Error correction term	0.0159	-0.0880*	-0.415***	-0.0775	-0.362***	-0.0935***	-0.160***	-0.216**	-0.235*	-0.153***	-0.0832**
	(0.0511)	(0.0467)	(0.114)	(0.0740)	(0.110)	(0.0259)	(0.0606)	(0.0866)	(0.142)	(0.0559)	(0.0396)
D(Log(Real GDP))											
D(Log(Real GDP),t-1)	0.638***	0.262	0.893***	0.370*	0.749***	0.619***	0.531***	0.327	0.674***	0.712***	0.351**
	(0.150)	(0.194)	(0.165)	(0.197)	(0.163)	(0.165)	(0.148)	(0.203)	(0.183)	(0.186)	(0.145)
D(Log(Real GDP),t-2)	-0.674***	-0.0644	-0.344	0.453*	-0.0896	-0.104	0.0948	0.308	-0.463***	-0.414*	-0.0798
	(0.196)	(0.189)	(0.250)	(0.239)	(0.234)	(0.181)	(0.188)	(0.245)	(0.178)	(0.213)	(0.144)
D(Log(Real GDP),t-3)	0.495***	0.217	0.175	-0.138	0.392*	0.261	-0.0559	0.239	0.321	0.258	0.110
	(0.183)	(0.173)	(0.232)	(0.225)	(0.217)	(0.183)	(0.186)	(0.236)	(0.223)	(0.230)	(0.139)
D(Log(Real GDP),t-4)	0.515**	-0.249**	0.0661	-0.240	0.0815	-0.136	0.0895	-0.155	0.580***	-0.214	0.489***
	(0.208)	(0.119)	(0.154)	(0.241)	(0.200)	(0.161)	(0.172)	(0.160)	(0.200)	(0.180)	(0.160)
D(Log(Total Government Expenditures))	-0.0191	0.0595***	0.0256	0.0516***	0.00990	0.0509***	0.0708***	0.0437**	-0.00569	0.00989	0.0665***
	(0.0176)	(0.0155)	(0.0303)	(0.0149)	(0.0219)	(0.0189)	(0.0195)	(0.0172)	(0.0199)	(0.0297)	(0.0205)
D(Log(Total Government Expenditures),t-1)	-0.00853	-0.0170	-0.0611*	0.0196	-0.0162	0.0266	0.0292	0.0296	-0.0452**	-0.0420*	0.0144
	(0.0174)	(0.0195)	(0.0352)	(0.0163)	(0.0242)	(0.0239)	(0.0251)	(0.0192)	(0.0207)	(0.0231)	(0.0234)
D(Log(Total Government Expenditures),t-2)	0.0269**	-0.00416	-0.0147	-0.00997	-0.00712	0.0368	0.0152	0.0193	0.0261	0.00564	0.00310
	(0.0132)	(0.0259)	(0.0339)	(0.0162)	(0.0230)	(0.0245)	(0.0262)	(0.0207)	(0.0232)	(0.0290)	(0.0224)
D(Log(Total Government Expenditures),t-3)	0.000933	-0.0406*	0.0324	0.0510***	0.0152	0.0215	0.0639***	0.00967	0.0156	0.0156	0.0364*
	(0.0120)	(0.0242)	(0.0302)	(0.0112)	(0.0199)	(0.0220)	(0.0233)	(0.0187)	(0.0250)	(0.0250)	(0.0214)

D(Log(Total Government Expenditures),t-4)	0.0276***	0.0150	-0.00851	0.0403***	0.00393	0.0484***	0.0520***	0.0186	0.0364*	0.0277	-0.00741
	(0.00974)	(0.0189)	(0.0312)	(0.0136)	(0.0217)	(0.0137)	(0.0149)	(0.0172)	(0.0197)	(0.0249)	(0.0171)
D(Log(Taxes revenues))	0.0827*	0.359***	0.0147	0.147***	0.0655	0.0568	0.169**	0.232***	0.111	0.0699	0.240***
	(0.0492)	(0.0606)	(0.0546)	(0.0532)	(0.102)	(0.0685)	(0.0782)	(0.0637)	(0.137)	(0.0675)	(0.0543)
D(Log(Taxes revenues),t-1)	-0.144**	0.142	-0.112**	-0.0910*	-0.0962	-0.168**	0.0191	-0.00654	-0.0718	-0.0343	0.0963
	(0.0610)	(0.0917)	(0.0555)	(0.0537)	(0.0919)	(0.0661)	(0.0856)	(0.0783)	(0.124)	(0.0788)	(0.0591)
D(Log(Taxes revenues),t-2)	0.0520	-0.0315	-0.116**	0.00156	-0.194**	-0.0481	-0.0738	-0.125	-0.119	0.0225	-0.0146
	(0.0696)	(0.0872)	(0.0570)	(0.0617)	(0.0959)	(0.0627)	(0.0907)	(0.0810)	(0.0957)	(0.0767)	(0.0722)
D(Log(Taxes revenues),t-3)	-0.0541	0.164**	-0.0848	0.119*	-0.217**	-0.0790	-0.181**	-0.142*	-0.163*	-0.00360	0.0581
	(0.0691)	(0.0725)	(0.0524)	(0.0615)	(0.104)	(0.0564)	(0.0848)	(0.0795)	(0.0989)	(0.0716)	(0.0602)
D(Log(Taxes revenues),t-4)	-0.181**	0.145**	-0.200***	0.0845	-0.102	-0.123*	-0.0429	-0.0747	-0.259***	0.0987	-0.136**
	(0.0727)	(0.0740)	(0.0627)	(0.0595)	(0.107)	(0.0635)	(0.0910)	(0.0757)	(0.0872)	(0.0716)	(0.0622)
Constant	0.0655	0.849**	0.619***	0.327	-0.0353	-0.525**	0.241	0.837**	1.099***	-0.486*	1.526***
	(0.415)	(0.357)	(0.201)	(0.273)	(0.343)	(0.241)	(0.230)	(0.347)	(0.398)	(0.254)	(0.578)
Observations	482	482	482	482	482	482	482	482	482	482	482
Log likelihood	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Number of countries	11	11	11	11	11	11	11	11	11	11	11

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Total government expenditure captures the discretionary component of government spending (the residuals of equation (3)). Standard errors are corrected using the Jackknife resampling procedure.