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The output effects of systematic and non-systematic fiscal policy changes in Greece

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Abstract

This paper investigates the effects of systematic (or rules-based) and non-systematic (exogenous) fiscal policy changes on output growth in Greece, focusing also on the composition of fiscal policy. Exogenous fiscal policy changes are associated with Keynesian responses (with the exception of net transfers and VAT). Systematic government spending cuts aiming at improving fiscal performance although they tend to have a Keynesian effect on output growth in the short term, they ultimately result in a non-Keynesian response, raising output growth. Systematic direct tax hikes, aiming at correcting fiscal imbalances, can have positive medium to long term growth effects.

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1. Introduction

On account of fiscal and macroeconomic imbalances, rising government bond yields and severe liquidity pressures Greece receives from May 2010, under strict conditionality, international financial assistance from the EU and the International Monetary Fund (IMF 2010). The EU-IMF financing agreement involves the implementation of the Economic Adjustment Programme (EAP) for Greece.

Despite implementation delays and reform fatigue the fiscal consolidation effort has been successful so far. The general government deficit was reduced from 15.6% of GDP in 2009 to about 6.0% of GDP in 2012, and the primary deficit was reduced to about 1.0% of GDP in 2012 from 10.4% of GDP in 2009.[1] However, this remarkable consolidation effort has come at a cost of a dramatic and continuing output contraction. According to recent estimates Greek output growth is expected to remain in negative territory for the sixth consecutive year in 2013 (IMF 2013).

The strong contraction has been attributed to reform fatigue and delays in the implementation of structural reforms, which impair the adjustment process (IMF 2013). However, Blanchard and Leigh (2013) recently showed that fiscal multipliers might have been underestimated (by a factor of 2-3) in the recent years in a number of countries implying that fiscal consolidation efforts had deeper recessionary effects than anticipated.

In view of these developments this paper assesses the output growth effects of fiscal policy changes in Greece, while also examining issues related to the composition effects of fiscal policy. Using a quarterly dataset we focus on the period 2000-2011. [2] Building on the fiscal rule literature (see Gali and Perotti 2003) we investigate the role non-systematic (or exogenous) and systematic (deficit and debt reducing) fiscal policy changes on output growth. This relates to the studies of e.g., Chung et al. (2007) and Taylor (2011) on the swings between rules-based and discretionary fiscal policy settings in the US. As pointed out by Taylor (2011) the moves toward more rules-based policies improved economic performance.

[1]Excluding the fiscal costs of banking sector support (see Eurostat, 2013).

[2] Data are obtained from the International Financial Statistics of the International Monetary Fund (IMF, 2012b), the OECD Economic Outlook and the OECD Quarterly National Accounts (OECD, 2012a, 2012b). We focus on the period that Greece was part of the euro area. Greece became part of the euro area on 1st January 2001 but its euro entry was already decided in 2000, therefore we start out data set in 2000 because expectations for a euro area entry were already formed. Another reason to look at the post-2000 era relates to the fact it is only since 2000 that the statistical authorities of Greece have started the production and dissemination of quarterly non interpolated fiscal and economic activity data. It should be taken into account that all fiscal and economic activity data have been approved by Eurostat, i.e., the data used in the analysis are not subject to any statistical deficiencies (see Eurostat, 2012).

The discussion on the systematic (deficit and debt reducing) fiscal policy changes is particular relevant because substantial part of fiscal operations in Greece in the period under examination was driven by the necessity to abide by EU rules and regulations (Excessive Deficit Procedure)[3] and the requirements of the Economic Adjustment Programme (EAP).[4]

Our findings indicate that exogenous fiscal policy changes are associated with Keynesian responses (with the exception of net transfers and VAT). Systematic cuts in government spending aiming at improving fiscal performance although they tend to have a Keynesian effect on output growth in the short term, they ultimately result in a non-Keynesian response, raising output growth. Systematic direct tax hikes, aiming at correcting fiscal imbalances, can have positive medium to long term growth effects.

The remainder of the paper is organised as follows. The next section presents data information and discusses the econometric methodology. In section 3 we present the main empirical findings. The last section includes a brief summary of the results and concluding remarks.[5]

2. Data and econometric methodology

2.1 The systematic and non-systematic components of discretionary fiscal policy

In order to extract the exogenous (non-systematic) discretionary component of fiscal policy variables we rely on the fiscal policy rule literature (see e.g. Bohn 1998; Gali and Perotti 2003). As stated by Gali and Perotti (2003) the residuals of the fiscal policy rule correspond to the shock or exogenous discretionary component of fiscal policy. Moreover, Perotti (1999) and Tagkalakis (2008) have followed an approach resembling to this one, i.e., by extracting fiscal shock from estimated quasi –VARs, which were then used to estimate the effect of fiscal policy on private consumption. Recently, Afonso et al. (2010) and Agnello et al. (2013) based on Fatas and Mihov (2003, 2006) used a similar technique to obtain the

[3] EU rules are constraining policy making in Greece since the early 1990s. In the 1990s, the Maastricht Treaty and the necessity to abide by specific criteria in order to gain access to the EMU constrained fiscal policy making. While in the 2000s, the Stability and Growth Pact and Excessive Deficit Procedure, and more recently the EU-IMF funded Economic Adjustment Programme for Greece played the part of external "anchor" on fiscal policy setting. Of course, during that period, as elsewhere, there were deviations from these rules-based approach and discretionary fiscal policy actions was undertaken.

[4] For example, as discussed by Weymes (2012) Greece has implemented, in the period 2010-2012, consolidation measures amounting to 20% of GDP, which are expected to cumulate to 33% of GDP by 2014. The Medium Term Fiscal Strategy 2013-2016 of the Greek government unveiled in Autumn 2012 included consolidation measures amounting to 7.2% of GDP for the period 2013-2014 and an additional 2.5% of GDP measures for 2015-2016 (European Commission, 2012).

[5] A supplementary material appendix provides additional information on data issues and empirical findings.

discretionary component of government spending[6]. Therefore, we estimate a typical fiscal policy rule (by means of IV) :

$$G_t \text{ (or } T_t) = \alpha * G_{t-1} \text{ (or } T_{t-1}) + \beta * Y_t + \gamma * pb_{t-1} + \delta * debt_{t-1} + \zeta * X_{t-1} + \eta * EDP_t + \varphi * EAP_t + \mu + \varepsilon_t \quad (1)$$

The fiscal policy rule is estimated by means of instrumental variables (IV) where the contemporaneous value of the growth rate of real GDP is instrumented by its first and second lagged values. We do that in order to control, to the extent possible, for reverse causation effects relative to economic activity. Reverse causation is not an issue for spending variables, because spending variables are hardly responding within the quarter to economic activity changes. This is more likely to be the case for tax revenues (i.e., revenues responding to economic activity) even with quarterly variables as have been discussed by Blanchard and Perotti (2002). Nevertheless, by instrumenting the real GDP growth rate variable with its lagged values we correct for endogeneity and automatic (within the quarter) cyclical effects. We correct for cyclical effects because the direct and automatic link between contemporaneous quarterly fiscal and economic activity variables breaks when we incorporate lagged (instead of contemporaneous) values of economic activity.

G (T) stands for the dependent government spending (taxes) variable, Y is the real GDP growth rate, pb is the primary balance to GDP ratio, and debt is the debt to GDP ratio. Each fiscal variable is assumed to be determined by previous period decisions or persistence effects (G_{t-1} *or* T_{t-1}), by real economic developments and by initial fiscal conditions. EDP is the dummy variable taking value 1 in the quarters that Greece was in periods of EU surveillance, i.e., under the Excessive Deficit Procedure. However, we treat differently the period that Greece is under joint EU-IMF surveillance, i.e., from May 2010 onwards. We introduce a dummy variable (EAP) taking value 1 in the recent quarters and zero otherwise.

The EDP dummy captures only the pre-EAP period. However, Greece is still in EDP in the recent years, but the fact that Greece receives financial assistance implies that the enhanced EU-IMF surveillance is stricter than before. Therefore, we control for that with the inclusion of the dummy variable EAP. X stands for the additional control variables used (see supplementary material appendix); μ is a constant term, ε is the residual of the fiscal policy rule which constitute the non-systematic or exogenous component.

[6] See also the following recent studies assessing the macroeconomic effects of fiscal policy: Afonso and Sousa (2011a, 2011b), Agnello e al. (2012), Afonso and Sousa (2012), Agnello and Sousa (2011, 2013).

Following the terminology of Gali and Perotti (2003), the fitted values of the fiscal policy rule (1) reflect the systematic response of the fiscal policy maker. This systematic component of fiscal policy making is driven by real GDP developments, persistence effects in setting the relevant fiscal policy instrument, initial fiscal conditions (i.e., primary balance and debt ratio developments), other (control) variables included in equation (1), as well as the need to comply with EU fiscal rules such as the EDP, and the requirements of EAP.

As a next step we wish to isolate the systematic response of the fiscal policy maker driven exclusively by deficit and debt reducing motives and the need to abide by EU fiscal rules and the EAP (but not affected by GDP). Hence, what we are interested in is the part of the fitted values from equation (1) that is driven by primary balance and debt ratio movements, as well as by the EDP and EAP variables. We thus construct the systematic fiscal policy component of each government spending and tax variable as a linear combination of these four variables, with the coefficient (c, d, h, f) of each variable being the respective coefficient estimate (γ, δ, η, φ) from equation (1). The systematic part is as follows:

$$\textit{Systematic component of } G_t \textit{ (or } T_t\textit{): } Gs_t \textit{ (or } Ts_t\textit{)} = c*pb_{t-1} + d*debt_{t-1} + h*EDP_t + f*EAP \quad (2)$$

In order for each one of the four variables to be include in equation (2) we require that the estimated coefficients have the appropriate sign. In particular, the government spending respond negatively when the primary balance (surplus) ratio falls ($c>0$), the debt ratio increase ($d<0$), and when in Excessive Deficit Procedure ($h<0$) or in the context of the EAP ($f<0$). Taxes should respond positively when the primary balance (surplus) ratio falls ($c<0$), when debt ratio increase ($d>0$) and when in EDP ($h>0$) or in the context of the EAP ($f>0$).[7]

By excluding the output growth variable the systematic component in equation (2) is not driven by output changes. Hence, the counter-cyclical or pro-cyclical systematic response of the fiscal policy instrument is excluded. What remains is only the systematic response to changes in fiscal variables, i.e., changes in spending and tax components/policy instruments that are driven by fiscal variables (debt ratio and/or primary balance movements), as well as fiscal decisions dictated by EU and national rules such as the EDP and the EAP in recent years. In principle, the systematic part that is included in the analysis tries to identify (and/or

[7] Therefore, it can be the case that the four variables are not always included in the systematic component of each G_t (or T_t) in equation (2). The variables included in each systematic component are shown in the supplementary material appendix. In the supplementary material appendix we also present the estimates of the fiscal policy rules (eq.1), as well as the extracted systematic and non-systematic components.

to proxy) these specific policy interventions that were aimed at lowering the deficit, debt ratio and to comply with EU rules.[8]

2.2 The effects of the systematic and non-systematic discretionary components of fiscal policy on economic activity

To analyse the effects of systematic and non systematic fiscal policy changes on economic activity we have estimated a growth equation (as in Agnello et al. 2013; Arnold et al. 2011; Cecchetti et al. 2011; Easterly and Rebello 1993; Furceri and Zdzienicka 2012) augmented with the fiscal policy components extracted from the aforementioned fiscal rules.

Building on earlier studies we start from empirical specifications of the form (which are estimated by means of OLS with robust standard errors):

$$Y_t = \mu + \alpha * Y_{t-1} + \gamma * \Phi_t + \Sigma^J_{j=1} \delta_j * \varepsilon_G \text{ (or } \varepsilon_T)_{t-j} + u_t \quad (3)$$

$$Y_t = \mu + \alpha * Y_{t-1} + \gamma * \Phi_t + \Sigma^J_{j=1} \delta_j * Gs \text{ (or } Ts)_{,t-j} + \upsilon_t \quad (4)$$

Where J=4, μ is the constant term u and υ are well behaved error term. The vector Φ includes the independent variables affecting the real per capita GDP growth rate (Y), i.e., the population growth rate, the percentage change of the terms of trade (ratio of export prices to import prices), and private debt households and non financial corporations to GDP ratio.

Following Agnello et al. (2013) the contemporaneous values of the exogenous (ε_G and ε_T) and the systematic (Gs and Ts) components of fiscal policy variables are excluded from specifications (3) and (4) to avoid reverse causality and feedback effects.

An issue that requires our attention is the following: equation (1) implies that fiscal policy responds systematically to economic developments, while equation (4) implies that economic developments are a function of systematic fiscal policy. This can create a "circularity problem" which could mean that we wouldn't be able to identify a truly causal relationship between the two variables, but rather a correlation. This would imply that changes in the macro-economy influence the response of fiscal authority and become part of the expectations of economic agents about the course of fiscal policy so, obviously, economic developments will also reflect the expectations about such developments in fiscal policy.

[8] The systematic and exogenous components of government spending and tax revenue are depicted in Figures 1-4 in the supplementary material appendix. The exogenous components of fiscal variables have the typical erratic movement. The systematic fiscal policy components are in line with the deficit and debt reducing motives of the policy makers and the need to abide by the EDP and to fulfil the EAP requirements, i.e. government spending is declining and tax revenues are increasing.

We try to deal with this problem in the following way. First, eq. (1) is estimated by means of IV, where the contemporaneous real GDP growth variable is instrumented with its first and second lagged values. This allows us to address any automatic impact effect from output growth to the fiscal policy instrument. Second, by construction the systematic response of the fiscal policy maker to output growth (the term $\beta^{*}Y_t$ in eq. (1)) is excluded from eq. (2). Last but not least, in eq. (4) we do not include the contemporaneous values (at time t) of the systematic components of fiscal policy variables, but rather only those from t-1 to t-4. This way we try to address any concerns of possible "circularity" problems in the estimation of eq. (4).

3. Empirical findings

3.1 The effects of the systematic and non-systematic discretionary fiscal policy changes on the growth rate of real GDP

Tables 1-4 present the empirical findings for governments spending and tax revenue variables, respectively. An exogenous increase (cut) in government spending has no particular effect on output growth in the short run as is shown in column 1, Table 1. However, it does increase (reduce) output growth after four quarters, i.e., a 1% increase (decrease) in government spending raises (lowers) per capita GDP growth rate by 0.124% four quarters after the policy change. Similarly, an increase in public investment impacts in a significant, but delayed fashion on output growth, a 1% increase in public investment raises per capita GDP growth rate by 0.059% after 4 quarters (column 3, Table 1). Hence, the behaviour of public investment shapes the output response profile to an exogenous change in total government spending.

An increase in net government transfers has negative effects on output growth, the effects are particularly significant in the first two quarters and in particular in the second one (column 4, Table 1). Exogenous changes in government consumption (column 2, Table 1) and in the government wage bill (column 5, Table 1) have no particular effect on output growth.[9]

Turning to systematic policy changes aiming at improving the fiscal situation of the country, we see that a cut in government spending depresses output growth in the short run (column 1, Table 2); though in the 3rd and 4th quarter the spending cut exerts a positive effect. Hence, while in quarters 1-2 the joint effect is 0.10% in quarters 3-4 it is -0.12%. Therefore, a cut in

[9] Regarding the other control variables, population growth and improvements in terms of trade exert a positive effect on output growth. On the contrary, an increase in the debt burden of the private sector has negative effects on growth.

spending, aiming ait improving the fiscal situation, while it initially lowers output growth, in later quarters it boosts growth performance. This could reflect a confidence boost (and a positive reaction from the public and financial markets) driven by the fact that future fiscal risks have diminished, and current and future increases in taxation are less likely.

Similarly, cuts in government consumption reduce output growth in the short run (column 2, Table 2) and lead to a positive effect in the outer quarters (but the effects are not particularly significant). The joint effects for quarter 1-2 and the quarters 3-4 are marginally insignificant in column 2 (Table 2). Systematic public investment cuts display a similar pattern; however, in this case the joint impact in quarters 3-4 is statistically significant (column 3, Table 2). This is exactly the opposite with what we found in the case of exogenous policy changes. Hence, even cuts in public investment that improve the overall fiscal condition can be expansionary in the medium term, but only if they are part of systematic policy response to contain fiscal imbalances. Net transfers (column 4, Table 2) and compensation of employees (column 5, Table 2) behave in a similar manner; but the findings are statistically significant only in the latter case. However, in that case the positive impact response in quarters 1-2 is more pronounced compared to the one in quarters 3-4.

Overall, there is evidence that exogenous fiscal policy changes are associated with Keynesian responses (with the exception of net transfers). Public investment changes drive the Keynesian response of output (in outer quarters) to government spending changes. Systematic policy changes tend to have a Keynesian effect on output growth in the short term, but ultimately result in a non-Keynesian response of output in the outer quarters. This is response profile is attributed to all four components of government spending, but only public investment and compensation of employees have significant joint 3^{rd}-4^{th} quarter effects.

According to our findings exogenous tax policy changes have (on average) negative but not statistically significant effects on output growth (Table 3). The only statistically significant effects relates to VAT revenue, however, our findings suggest that an increase in VAT revenue will have a positive effect on output growth four quarters after the policy change.

Turning to systematic tax policy changes aiming at improving the fiscal conditions we find evidence that an increase in net taxes depress output in the short run (quarter 1), but this effect fades away in the coming quarter (quarter 2), leaving practically unaffected output growth in the coming quarters (column 1, Table 4). We find evidence that a direct tax increase (as well as increase in the implicit tax rate on income), aiming at correcting fiscal

imbalances, can lead to higher growth rate (columns 2-3, Table 4), as depicted by the joint effect in quarters t-1 to t-4. Turning to VAT variables there is mixed evidence. With both positive and negative responses, the overall effect (joint effect t-1 to t-4) is negative in case of VAT revenue and positive in case of the implicit VAT rate, however, they are both insignificant.

Overall, as regards tax policy changes the evidence is not clear cut. However, higher direct taxes reflecting a systematic policy response to improve fiscal conditions can be associated with higher output growth, though in case of exogenous policy changes the response in negative and insignificant.

4. Summary and conclusions

Building on the fiscal rules literature (e.g. Gali and Perotti 2003) and earlier studies examining the effects of fiscal policy (e.g., Afonso and Sousa 2012; Agnello and Sousa 2011; Agnello et al. 2013) we try to disentangle the impact of systematic and non-systematic (or exogenous) policy changes on output growth, while also focusing on the composition effects of fiscal policy.

According to our findings, there is mixed evidence as regards tax policy changes, but there is some indication that higher direct taxes, reflecting a systematic policy response to improve fiscal conditions, can be associated with higher output growth in the medium term. We find significant evidence that exogenous fiscal policy changes are associated with Keynesian output responses (with the exception of net transfers). Systematic policy changes aiming at improving the fiscal situation tend to have a Keynesian effect on output growth in the short term but ultimately result in a non-Keynesian output response in outer quarters.

These findings imply spending cuts and tax increases will most likely depress output in the short run. However, if they are undertaken in the context of a systematic policy response aiming to correct fiscal imbalances and abide by national and EU fiscal rules, they can result in higher output growth in the medium to long term. The positive response is most likely driven by a confidence boost on the part of the public and international investors, which reflects that future fiscal risks are reduced.

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Table 1: The output effects of exogenous government spending changes

Dependent variable:	**Growth rate of GDP per capita**				
	1	**2**	**3**	**4**	**5**
Variable of interest:	**Government spending**	**Government consumption**	**Government Investment**	**Net transfers**	**Compensation of employees**
Dependent variable (t-1)	0.218 (1.44)	0.377 (2.11)**	0.286 (2.12)**	0.314 (2.31)**	0.369 (2.16)**
Population growth (t)	0.029 (3.89)***	0.023 (2.77)***	0.023 (3.75)***	0.030 (4.13)***	0.023 (3.10)***
Private debt/GDP(t)	-0.001 (-4.39)***	-0.0009 (-3.33)***	-0.001 (-5.27)***	-0.0009 (-4.34)***	-0.0009 (-3.68)***
Percentage change in terms of trade(t)	0.429 (3.29)***	0.252 (1.64)	0.349 (3.19)***	0.371 (3.68)***	0.262 (1.71)*
constant	0.015 (0.79)	0.0133 (0.69)	0.038 (1.61)	-0.010 (-0.46)	0.014 (0.62)
Growth of real government spending variable(t-1)	-0.017 (-0.26)	-0.020 (-0.32)	0.0009 (0.05)	-0.054 (-1.56)	-0.004 (-0.05)
Growth of real government spending variable(t-2)	-0.012 (-0.24)	0.036 (0.55)	-0.016 (-1.27)	**-0.067** **(-2.08)****	-0.006 (-0.15)
Growth of real government spending variable (t-3)	0.041 (0.56)	-0.045 (-0.52)	0.021 (1.24)	-0.010 (-0.36)	-0.039 (-0.54)
Growth of real government spending variable (t-4)	**0.124** **(2.21)****	0.004 (0.05)	**0.059** **(1.94)***	-0.016 (-0.74)	0.018 (0.24)
Join effect (t-1 and t-2)	-0.028 (-0.33)	0.016 (0.13)	-0.015 (-0.61)	**-0.120** **(-2.42)****	-0.010 (-0.11)
Joint effect (t-3 and t-4)	**0.165** **(2.38)****	-0.041 (-0.31)	**0.081** **(2.67)****	-0.026 (-0.71)	-0.022 (-0.19)
Joint (significance) effect **(t-1 to t-4)**	0.137 (1.11)	-0.025 (-0.12)	0.065 (1.29)	**-0.146** **(-2.26)****	-0.032 (-0.16)
No of Obs	38	38	38	38	38

R-sq	0.9111	0.8977	0.9259	0.9168	0.8960
F-test (p-value)	F(8, 29) = 48.57 (0.000)	F(8, 29) = 51.98 (0.000)	F(8, 29) = 101.89 (0.000)	F(8, 29) = 51.19 (0.000)	F(8, 29) = 40.98 (0.0000)

Notes:***,**,* indicate significance at 1%, 5% and 10% level of significance, respectively. t-statistics are reported in parenthesis; OLS with robust standard errors.

Table 2: The output effects of systematic government spending changes

Dependent variable:	**Growth rate of GDP per capita**				
	1	**2**	**3**	**4**	**5**
Variable of interest:	**Government spending**	**Government consumption**	**Government Investment**	**Net transfers**	**Compensation of employees**
Dependent variable (t-1)	0.469 (3.05)***	0.436 (2.94)***	0.347 (2.42)**	0.376 (2.81)***	0.440 (2.93)***
Population growth (t)	0.014 (1.50)	0.011 (1.13)	0.024 (3.24)***	0.025 (3.05)***	0.011 (1.09)***
Private debt/GDP(t)	-0.0007 (-3.15)***	-0.0006 (-2.73)***	-0.001 (-4.53)***	-0.001 (-3.90)***	-0.0006 (-2.77)***
Percentage change in terms of trade(t)	0.155 (1.28)	0.185 (1.61)	0.108 (0.90)	0.161 (1.37)	0.184 (1.58)
constant	0.025 (0.83)	0.033 (1.12)	0.021 (0.98)	0.016 (0.79)	0.033 (1.13)
Growth of real government spending variable(t-1)	**0.070** **(1.82)***	**0.201** **(2.35)****	0.023 (0.17)	0.123 (1.67)	**0.232** **(2.39)****
Growth of real government spending variable(t-2)	0.029 (1.38)	-0.022 (-0.24)	0.091 (0.64)	-0.098 (-0.87)	-0.014 (-0.14)
Growth of real government spending variable (t-3)	**-0.066** **(-4.41)*****	-0.057 (-0.77)	-0.161 (-1.19)	-0.049 (-0.47)	-0.073 (-0.92)
Growth of real government spending variable (t-4)	**-0.055** **(-1.89)***	-0.073 (-1.15)	-0.193 (-1.52)	-0.050 (-0.61)	-0.088 (-1.26)
Join effect (t-1 and t-2)	**0.100** **(1.90)***	0.179 (1.65)	0.113 (0.98)	0.025 (0.27)	**0.218** **(1.80)***

Joint effect (t-3 and t-4)	**-0.122** **(-4.06)*****	-0.130 (-1.62)	**-0.354** **(-3.37)*****	-0.099 (-1.07)	**-0.161** **(-1.85)***
Joint (significance) effect **(t-1 to t-4)**	-0.022 (-0.34)	0.049 (0.49)	**-0.241** **(-2.43)*****	-0.074 (-1.29)	0.056 (0.49)
No of Obs	42	42	42	42	42
R-sq	0.8914	0.8925	0.8998	0.8939	0.8924
F-test (p-value)	F(8, 33) = 303.77 (0.000)	F(8, 33) = 64.49 (0.0000)	F(8, 33) = 62.32 (0.000)	F(8, 33) = 53.18 (0.000)	F(8, 33) = 67.50 (0.000)

Notes:***,**,* indicate significance at 1%, 5% and 10% level of significance, respectively. t-statistics are reported in parenthesis; OLS with robust standard errors.

Table 3: The output effects of exogenous tax revenue changes

Dependent variable:	**Growth rate of GDP per capita**				
	1	**2**	**3**	**4**	**5**
Variable of interest:	**Net taxes**	**Direct taxes**	**Implicit tax rate on income**	**VAT**	**Implicit VAT rate**
Dependent variable (t-1)	0.372 (2.44)**	0.367 (2.63)**	0.392 (2.77)***	0.381 (2.60)**	0.357 (2.54)**
Population growth (t)	0.024 (3.35)***	0.024 (3.78)***	0.028 (2.86)***	0.026 (4.07)***	0.025 (3.85)***
Private debt/GDP(t)	-0.0009 (-3.62)***	-0.0009 (-3.77)***	-0.0009 (-3.56)***	-0.0008 (-3.49)***	-0.0008 (-3.74)***
Percentage change in terms of trade(t)	0.286 (2.26)**	0.237 (1.96)*	0.284 (2.22)**	0.293 (2.67)***	0.304 (2.48)*
constant	0.007 (0.32)	0.012 (0.50)	-0.009 (-0.36)	-0.005 (-0.23)	0.006 (0.31)
Growth of real tax variable (t-1)	-0.041 (-1.10)	-0.098 (-0.69)	-0.071 (-1.36)	-0.001 (-0.03)	-0.012 (-0.45)
Growth of real tax variable (t-2)	0.062 (1.61)	-0.077 (-0.28)	-0.032 (-0.69)	0.0008 (0.01)	0.011 (0.36)
Growth of real tax variable (t-3)	-0.033 (-0.94)	-0.112 (-1.16)	-0.007 (-0.15)	0.026 (0.53)	0.0006 (0.02)
Growth of real tax variable (t-	0.008	0.014	-0.079	**0.097**	0.038

4)	(0.19)	(0.20)	(-1.09)	**(2.29)****	(1.52)
Join effect (t-1 and t-2)	0.021 (0.37)	-0.113 (-1.16)	-0.103 (-1.33)	-0.0003 (-0.00)	0 .0001 (0.00)
Joint effect (t-3 and t-4)	-0.024 (-0.51)	0.014 (0.20)	-0.087 (-0.87)	**0.123** **(1.92)***	0.038 (1.05)
Joint effect **(t-1 to t-4)**	-0.002 (-0.04)	-0.098 (-0.69)	-0.190 (-1.38)	0.123 (0.98)	0 .039 (0.54)
No of Obs	38	38	38	38	38
R-sq	0.9053	0.9033	0.9073	0.9082	0.9017
F-test (p-value)	F(8, 29) = 43.29 (0.000)	F(8, 29) = 56.93 (0.000)	F(8, 29) = 48.58 (0.000)	F(8, 29) = 48.56 (0.000)	F(8, 29) = 42.85 (0.000)

Notes:***,**,* indicate significance at 1%, 5% and 10% level of significance, respectively. t-statistics are reported in parenthesis; OLS with robust standard errors.

Table 4: The output effects of systematic tax revenue changes

Dependent variable:	**Growth rate of GDP per capita**				
	1	**2**	**3**	**4**	**5**
Variable of interest:	**Net taxes**	**Direct taxes**	**Implicit tax rate on income**	**VAT**	**Implicit VAT rate**
Dependent variable (t-1)	0 .366 (2.71)**	0 .305 (2.03)**	0 .305 (2.03)**	0.389 (2.43)**	0.441 (2.88)**
Population growth (t)	0.021 (2.83)***	0.018 (2.48)**	0.018 (2.48)**	0.018 (1.79)*	0.041 (2.66)**
Private debt/GDP(t)	-0.0008 (-2.95)***	-0.001 (-4.58)***	-0.001 (-4.58)***	-0.0007 (-2.27)**	-0.0015 (-2.92)***
Percentage change in terms of trade(t)	0 .211 (1.90)*	0 .182 (1.43)	0 .182 (1.43)	0.241 (1.88)*	0.234 (2.25)**
constant	0 .0128 (0.73)	0 .042 (2.04)**	0 .042 (2.04)**	0.030 (0.64)	-0.171 (-1.19)
Growth of real tax variable (t-1)	**-0.072** **(-1.93)***	0 .166 (1.10)	0.120 (1.10)	-0.009 (-0.10)	**0.339** **(2.43)****
Growth of real tax variable (t-2)	**0 .078** **(2.23)****	0 .0104 (0.05)	0.007 (0.05)	0.187 (1.35)	**-0.392** **(-1.98)****
Growth of real tax variable (t-	-0.011	0 .011	0.008	-0.188	0.354

3)	(-0.27)	(0.06)	(0.06)	(-1.51)	(1.57)
Growth of real tax variable (t-4)	-0.015 (-0.32)	0 .106 (0.77)	0.076 (0.77)	-0.024 (-0.19)	-0.110 (-0.59)
Join effect (t-1 and t-2)	0 .005 (0.14)	0 .177 (1.12)	0.127 (1.12)	**0.178** **(1.82)***	-0.053 (-0.45)
Joint effect (t-3 and t-4)	-0.027 (-0.73)	0 .117 (0.71)	0.084 (0.71)	**-0.212** **(-1.82)***	0.244 (1.15)
Joint effect **(t-1 to t-4)**	-0.021 (-0.61)	**0 .294** **(2.69)*****	**0.212** **(2.69)*****	-0.035 (-0.38)	0.191 (1.24)
No of Obs	42	42	42	39	39
R-sq	0.8908	0.8906	0.8906	0.8979	0.9164
F-test (p-value)	F(8, 33) = 58.59 (0.000)	F(8, 33) = 33.37 (0.000)	F(8, 33) = 33.37 (0.0000)	F(8, 30) = 70.57 (0.000)	F(8, 30) = 61.58 (0.000)

Notes:***,**,* indicate significance at 1%, 5% and 10% level of significance, respectively. t-statistics are reported in parenthesis; OLS with robust standard errors.