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Fiscal Policy Effectiveness in a Small Open Economy: Estimates of Tax and Spending Multipliers in Paraguay

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Fiscal Policy Effectiveness in a Small Open Economy: Estimates of Tax and Spending Multipliers in Paraguay[1]

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Abstract

This paper presents estimates of fiscal multipliers in Paraguay following different econometric techniques and identification approaches. The results point to multipliers for capital expenditure that are substantially higher than multipliers for current expenditure. In addition, the evidence suggests that tax multipliers are close to zero when using conventional identification approaches, but estimates can be much larger when considering the "narrative" approach. One implication of the results is that the balanced budget multiplier for Paraguay i.e. the effect of on output of an increase in expenditures (in particular capital expenditure) financed by taxes is likely to be positive.

JEL Classification Numbers: E62, H20, H50, O11

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I. INTRODUCTION

This paper presents estimates of fiscal multipliers in Paraguay following different estimation techniques and identification approaches. It also discusses selected recent studies with a special focus on empirical results for developing countries (see Annex A). An examination of multipliers in Paraguay is timely for a number of reasons, including the government's desire to boost investment spending in light of the country's sizeable infrastructure needs as well as several recent revenue mobilization efforts with technical assistance support from the IMF and other partners.

Estimating multipliers for expenditures and taxes empirically is warranted because different theoretical frameworks yield opposing predictions regarding the impact of discretionary fiscal policy on output. For example, in neoclassical models, an unexpected increase in government expenditures represents a negative wealth shock (given higher expected taxes in the future to satisfy the government's intertemporal budget constraint) leading to a fall in consumption, increase in labor supply, and a decrease in real wages for a given level of labor demand (Engemann, Owyang and Zubairy, 2008). Nevertheless, in models with nominal rigidities and credit constraints, consumption and real wages are expected to rise in response to a positive government spending shock.

Furthermore, it is not certain how specific characteristics of emerging economies like Paraguay affect the size of fiscal multipliers compared to estimates obtained for advanced economies (Batini et al, 2014). For example, credit constraints are likely to be more prominent in developing countries, which would a priori suggest higher multipliers, but these economies also tend to be smaller and more open, which could imply lower multipliers because of "leakages" in demand through higher imports. In addition, standard models also suggest that countries with flexible exchange rate regimes would tend to present smaller multipliers as real exchange rate movements may offset some of the impact of fiscal policy on output.

We follow Ramey and Zubairy (2016) and define multipliers as the cumulative response in GDP relative to the cumulative government spending/taxes during a given period ("cumulative" multipliers). Alternative definitions of fiscal multipliers have been frequently considered in the literature, such as the ratio of the peak of the output response to an initial government spending/tax shock (Blanchard-Perotti, 2002) or the ratio of the average output response to an initial fiscal policy shock (Auerbach & Gorodnichenko, 2012). Nevertheless, we believe that cumulative multipliers considered here are more directly linked to the question of relevance to policy makers (i.e. calculating by how many Guaranies GDP changes if government expenditures or taxes change by X Guaranies). Moreover, it is important to calculate multipliers by comparing the integral of output responses to the integral of expenditures/revenues (rather than impact effects) because frequently the effects of fiscal policy build over time.

The paper is organized as follows. In section II, we present estimates of government spending and tax multipliers using VAR models and conventional identification strategies. Subsequently, in section III we discuss estimates of cumulative multipliers obtained using the local projection method. In Section IV, we explore two attempts to address the problem of

identification. We replicate the strategy of Kraay (2014) and use predicted disbursements by official creditors to identify exogenous government spending. On the tax side, we use a narrative approach as in Romer and Romer (2010). Finally, section V presents conclusions and policy implications.

II. ESTIMATING MULTIPLIERS WITH VARS

A. Government Spending Multipliers

We begin by estimating multipliers using VAR models at a quarterly frequency, which has been the econometric approach most commonly used in the literature. We follow the Blanchard & Perotti (2002) identification of expenditure shocks, which assumes that government expenditures are not affected by shocks to GDP within the same quarter (i.e. government expenditures are weakly exogenous). We try to consider separately multipliers for current expenditure and multipliers for capital expenditure.

We estimate a number of three-dimensional VARs with seasonally adjusted data in log levels[2] over the period 1998:Q1-2015:Q2 that include real current government expenditure (deflated by the GDP deflator); or real capital expenditure; real GDP; or real non-agro non-energy GDP; the change in the real effective exchange rate; and a deterministic linear trend (included as an exogenous variable). Annex B provides a brief description of the variables used and their respective sources.

Figure 1 presents cumulative orthogonalized impulse responses over 20 quarters for the different VARs estimated. As expected, output responds positively to both types of government expenditure shocks, but confidence bands are wide and impulse responses are only significant at longer horizons. Stability checks presented in Annex C confirm that all the eigenvalues of the companion matrix lie inside the unit circle and therefore the estimated models satisfy the stability condition.

Table 1 presents estimates of the multiplier built from the impulse responses of the different models. More specifically, the elasticities obtained from the VARs in log levels were converted to changes in Guaranies by dividing by the average ratio of current or capital expenditures to GDP over the sample, such that $\frac{\Delta Y}{\Delta G} = \frac{\Delta \ln(Y)}{\Delta \ln(G)} * \frac{Y}{G}$.

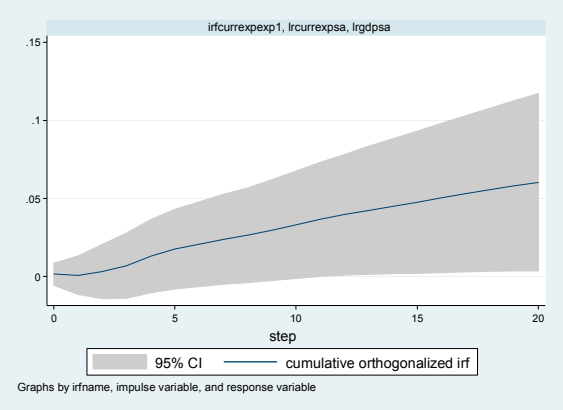
Nevertheless, as discussed by Ramey & Zubairy (2015) multipliers calculated through this transformation are subject to mismeasurement and biases (most notably related to the fact that the ratios of expenditure to GDP tend to change over the sample). The estimated impact multipliers are close to zero in magnitude and are not statistically significant in all cases i.e. when considering total GDP, non-agro non-energy GDP, current expenditure and capital expenditure.

[2] Ramey (2011) discusses the advantages of estimating the models in log levels to calculate multipliers.

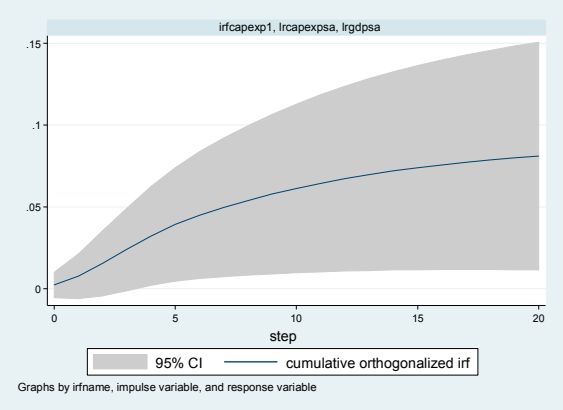
These results are in line with the ones obtained by Ilzetzki, Mendoza, & Vegh (2013) for government consumption in developing countries, but not for capital expenditure, as these authors find a multiplier of around 0.6 on impact using a panel VAR approach (see Annex A). Estevao & Samake (2013) also present estimates of multipliers for government expenditures of around 0 on impact for a number of Central American countries, whereas Matheson & Pereira (2016) using a similar approach to the one described in this paper obtain an expenditure multiplier of 0.5 on impact for Brazil.

Figure 1. Cumulative Orthogonalized Impulse Responses to Government Spending Shocks

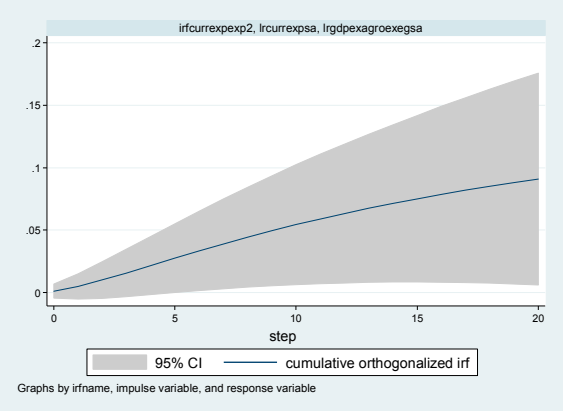
Response of total GDP to Current Expenditure Shock



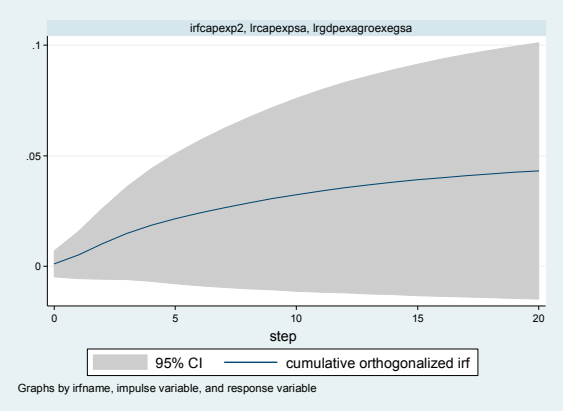
Response of total GDP to Capital Expenditure Shock



Response of non-Agro non-Energy GDP to Current Expenditure Shock



Response of Non-Agro Non-Energy GDP to Capital Expenditure Shock



Bootstrapped standard errors (500 repetitions). Shaded area represents 95 percent confidence interval. Sample period 1998:Q1-2015:Q2. Lag length selection based on AIC, SBC, and LR test. Higher order VAR used when conflicting results were obtained.

Over longer horizons, estimates of spending multipliers in Paraguay increase to between 0.2 to 0.5 for current expenditure and between 0.5 to 2.1 for capital expenditure, although statistical significance varies depending on whether we consider total or non-agriculture non-energy GDP. The cumulative multipliers obtained for capital expenditure are in the same order of magnitude of the estimates presented by Ilzetzki, Mendoza & Vegh (2013) for developing countries, but are somewhat higher than the ones obtained by Estevao & Samake (2013) for Central America and Vtyurina & Leal (2016) for Peru. The results obtained for

Paraguay contrast with the cumulative multiplier of around 0 for capital expenditure estimated by Matheson & Pereira (2016) for Brazil.

Table 1. Estimates of Government Spending Multipliers in Paraguay (Cumulative)

	Total GDP	Non-Agro Non-Energy GDP
Current Expenditure		
t=0	0.0	0.0
t=8	0.2*	0.2**
t=20	0.5**	0.5**
Capital Expenditure		
t=0	0.1	0.0
t=8	1.4**	0.5
t=20	2.1**	0.8

Note: ** indicates statistical significance at the 5 percent level. * indicates significance at the 10 percent level.

To check the robustness of the results obtained, we also estimate VAR models using more granular quarterly fiscal data from the Ministry of Finance following the GFS 2001 presentation that allows us analyze current primary expenditure (excluding interest payments) as well as capital expenditure. This data is available for the period 2003:Q1-2016:Q1. Re-estimating the models over this period is also useful because of the possibility of a structural break in GDP in 2003 (see Colman, Franco, and Tello, 2016 for a discussion and Annex B for a depiction of the GDP series). The estimated impulse responses and multipliers are presented in Annex D. While impact multipliers continue to be estimated at around zero, the point estimates over longer horizons are generally lower than the ones previously reported. Multipliers are estimated to be around 0.1 for real current primary expenditure and between 0.4 to 0.9. for capital expenditure.

B. Tax Multipliers

We now turn our attention to the estimation of tax multipliers by including different measures of tax revenue shocks in the VARs previously described. Riera-Crichton, Vegh, & Vuletin, (2016) discuss the pitfalls in identification and measurement of tax shocks and advocate the use of "narrative" approaches (for further discussion of the narrative approach see section IV of this paper and Romer and Romer, 2010 for an application to the United States) rather than imposing restrictions in VAR models. As far as the measurement of tax policy is concerned, these authors favor the use of statutory tax rates over revenue-based measures.

We follow two different strategies within the VAR framework in terms of identification assumptions in this section. For models that include cyclically-adjusted revenues[3], we assume that tax policy does not respond contemporaneously (within the same quarter) to output shocks. Nevertheless, in models where unadjusted revenues are included, we allow for a contemporaneous response to GDP shocks in order to capture automatic stabilizers.

Figure 2 presents the impulse responses obtained. The models include four endogenous variables: real total government expenditures; real GDP (or real non-agriculture non-energy GDP); real tax revenues (or the change in cyclically adjusted tax revenues); and changes in the real effective exchange rate. A deterministic linear time trend is included as an exogenous variable. As in the previous section, stability checks show that the eigenvalues of the companion matrix for the models estimated lie inside the unit circle, satisfying the stability condition (Annex C).

The results point to a negative response of output to tax shocks (as expected) in most cases with the exception of the bottom left panel, although confidence bands are wide. The multipliers implied by these impulse response functions are close to zero in magnitude and are not statistically significant in most cases, as shown in Table 2. The notable exception is the cumulative multiplier of cyclically adjusted tax revenues on non-agro non-energy GDP, which is estimated at -0.4 after 5 years (-0.2 after two years) and is significant at conventional levels. The finding that tax multipliers are larger (in magnitude and statistical significance) for non-agro non-energy GDP is not surprising, given the virtual absence of taxation in the agricultural sector up to recent periods and the relatively large share of this sector in total GDP.

In addition, the results obtained differ from Gunter, Riera-Crichton, Vegh & Vuletin (2016) and Matheson & Pereira (2016), who find cumulative multipliers of around -2 for developing countries and Brazil, respectively. While Matheson & Pereira (2016) use a similar approach to the one presented here, Gunter, Riera-Crichton, Vegh & Vuletin (2016) identify policy shocks through the narrative approach focusing on changes in VAT rates. Colman, Franco, & Tello (2016) using a structural VAR approach also find tax multipliers in Paraguay that are close to zero.

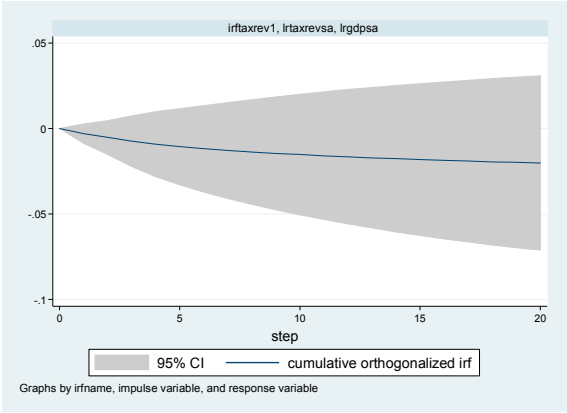
As in the previous section, we also estimate the models using quarterly fiscal data from the Ministry of Finance over the period the period 2003:Q1-2016:Q1 for robustness. The results are presented in Annex D. Estimates of the tax multiplier over this period are also close to zero.

[3] Defined using the equation below, with an elasticity (η) of 1 for Paraguay following David and Novta (2016).

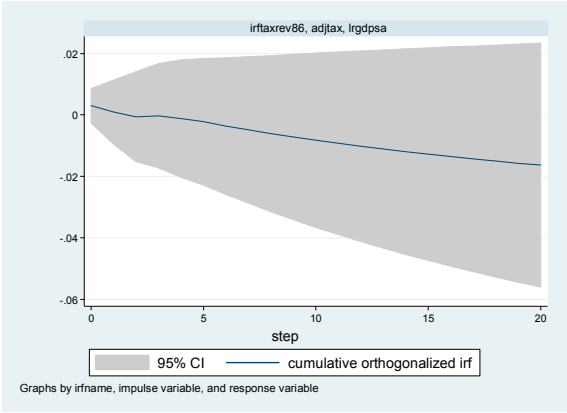
$$\Delta \text{adjusted revenue} = \ln(\text{tax revenue}_t) - \ln(\text{tax revenue}_{t-1}) - \eta * [\ln(Y_t) - \ln(Y_{t-1})]$$

Figure 2. Paraguay: Cumulative Orthogonalized Impulse Responses to Tax Shocks

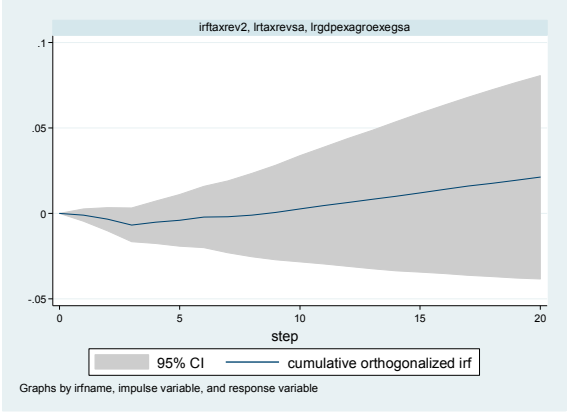
Response of total GDP to Tax Revenue Shock



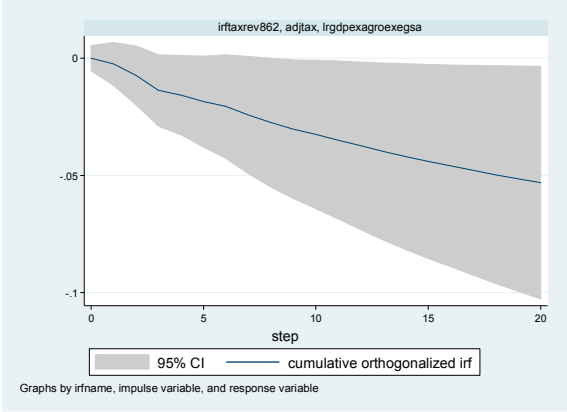
Response of total GDP to Cyclically Adjusted Revenue Shock



Response of non-Agro non-Energy GDP to Tax Revenue Shock



Response of Non-Agro Non-Energy GDP to Cyclically Adjusted Revenue Shock



Bootstrapped standard errors (500 repetitions). Shaded area represents 95 percent confidence interval. Sample period 1998:Q1-2015:Q2. Lag length selection based on AIC, SBC, and LR test. Higher order VAR used when conflicting results were obtained.

Table 2. Estimates of Tax Multipliers in Paraguay (Cumulative)

	Total GDP	Non-Agro Non-Energy GDP
Real Tax Revenue		
t=0	0.0	0.0
t=8	-0.1	0.0
t=20	-0.2	0.1
Cyclically Adjusted Tax Revenue		
t=0	0.0	0.0
t=8	-0.1	-0.2*
t=20	-0.2	-0.4**

Note: ** indicates statistical significance at the 5 percent level. * indicates significance at the 10 percent level.

III. ESTIMATING MULTIPLIERS WITH THE LOCAL PROJECTION METHOD

In this section, we use Jorda's (2005) local projection (LP) method as an alternative econometric approach to obtain estimates of multipliers for Paraguay. The method entails the estimation of a series of regressions for each horizon h, such that:

$$z_{t+h} = \alpha_h + \sum_{i=1}^{n} \varphi_{ih} x_{t-i} + \beta_h shock_t + \varepsilon_{t+h}, \text{ for } h = 0,1,2,...$$

Where z is the variable of interest, x is a vector of control variables (which includes in our case lags of GDP, lags of government spending, and changes in the real effective exchange rate) and "shock" is the identified shock to government spending. The coefficient β_h is the response of z at horizon t+h to the shock at time t. This method can be adapted to estimate non-linear state-dependent models (Ramey & Zubairy, 2015 and 2016; Dell'Erba, Koloskova, & Poplawski-Ribeiro, 2014).

One of the advantages of this approach is that it does not constrain the shape of the impulse response functions and is therefore less sensitive to misspecification than standard VAR models. Nevertheless, estimates also tend to be more erratic than the ones obtained from VARs. In addition, for state-dependent models one does not need to make assumptions about transitions from different states and feedback of shocks to states, as the estimates already incorporate transitions that occur on average in the data (Ramey & Zubairy, 2015).

Furthermore, in the LP method, multipliers can be obtained directly, rather than calculated from elasticities. Ramey & Zubairy (2016) argue that in a dynamic setting, the relevant multipliers that are of direct interest to policy makers should be calculated as the cumulative response of GDP divided by the cumulative government spending over a given horizon, rather than considering peak responses or average responses relative to an initial policy shock, because often the effects of government spending build-up over time. This "integral" multiplier can be estimated in a simple way under the LP method by focusing on the following instrumental variable regression (with the fiscal shock serving as an instrument for $\sum_{j=0}^{h} g_{t+j}$):

$$\sum_{j=0}^{h} y_{t+j} = \alpha_h + \varphi_h(L) x_{t-1} + m_h \sum_{j=0}^{h} g_{t+j} + \omega_{t+h}, \text{ for h=0,1,2,...}$$

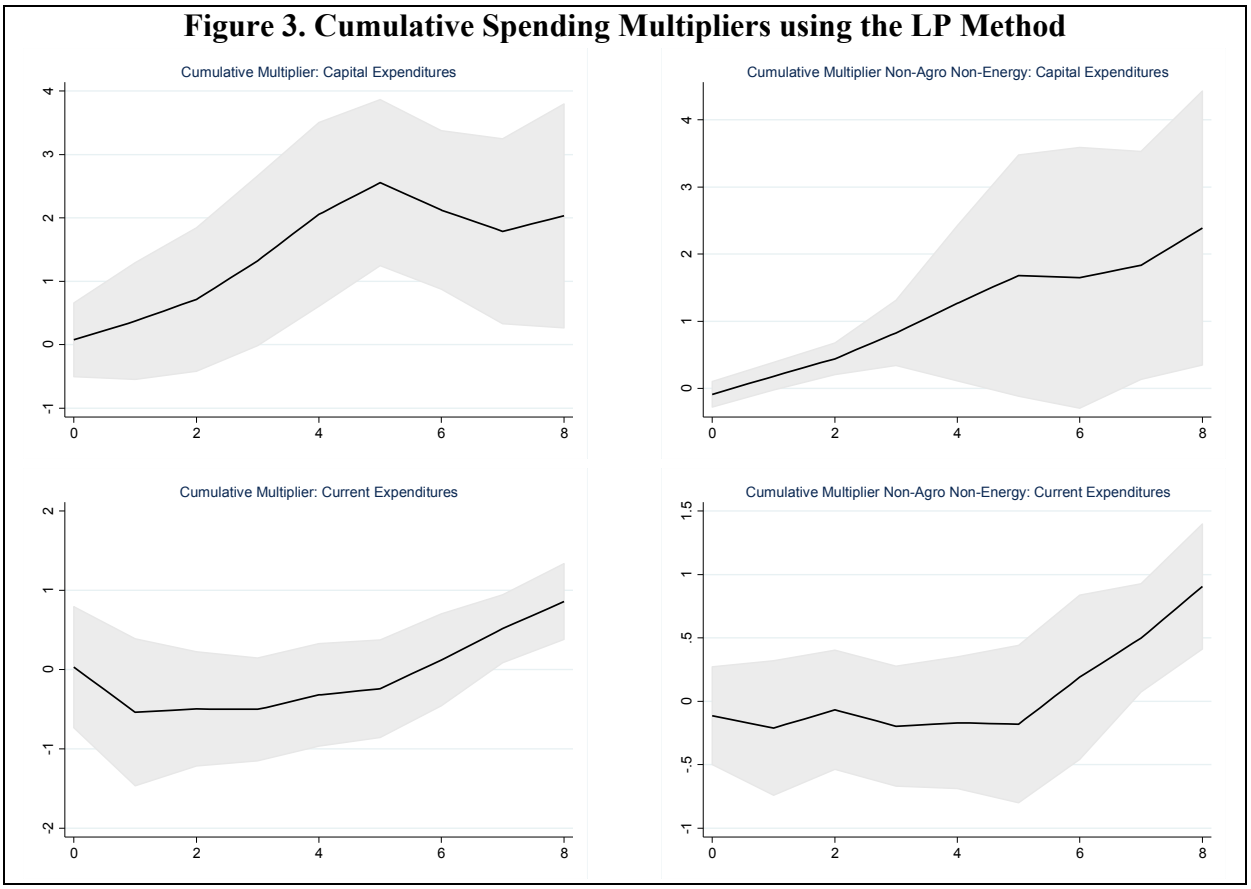
In Figure 3 we present estimates of cumulative spending multipliers using the LP method and the Blanchard-Perotti identification. In this case, the shock is given by the residuals of a regression of real government expenditures on lagged expenditures; lagged real GDP and lagged changes in the real effective exchange rate (akin to innovations in a VAR model). Ninety-five percent heteroscedasticity and autocorrelation consistent (HAC) standard errors bands are reported because of the serial correlation of error terms introduced by the use of successive leads of the dependent variable. GDP and government expenditures were normalized by trend GDP (as in Ramey & Zubairy, 2016), where the trend was obtained

using the HP filter. The top two panels present estimates for multipliers on total GDP and the bottom panels estimates for multipliers on non-agro non-energy GDP.

We can confirm some of the previous evidence from VAR models that multipliers for capital expenditure appear to be higher than multipliers for current expenditure. In general, multipliers seem to be more precisely estimated (smaller standard errors) under this approach. While the estimated multiplier for capital expenditure on total GDP is zero on impact, it reaches 2 after four quarters and is statistically significant at the 5 percent level, a result that is broadly in line with VAR models.

In the case of current expenditure, the cumulative multiplier for total GDP only becomes statistically significant after seven quarters and reaches a value of 0.9, which is substantially larger than what was obtained using VAR models. Multipliers for current and capital expenditures on non-agro non-energy GDP (bottom panels) are of similar size to the ones obtained for total GDP under this approach and contrary to VAR models, multipliers for capital expenditure on non-agro non-energy GDP are statistically significant.

Figure 3. Cumulative Spending Multipliers using the LP Method



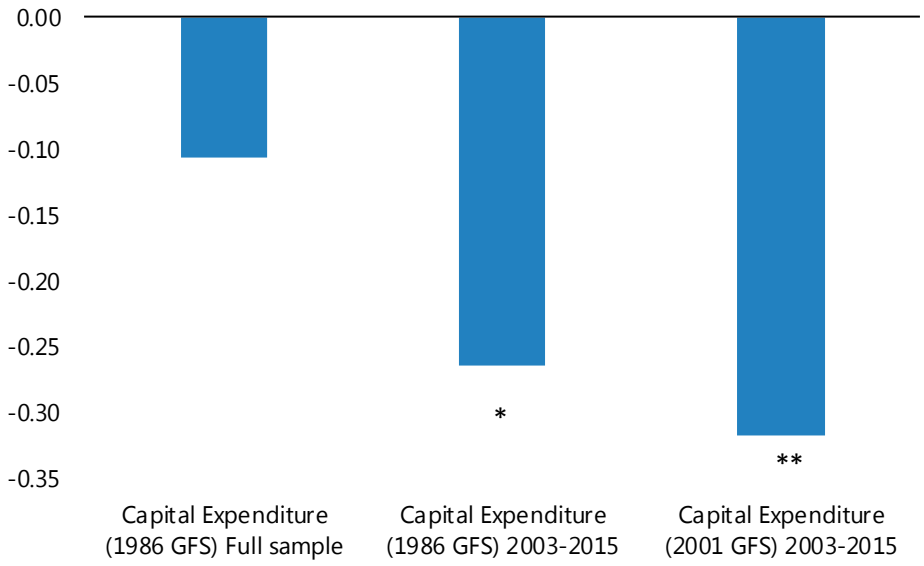
Shaded area represents 95 percent confidence interval (HAC standard error bands). Sample period 1998:Q1-2015:Q2. Multipliers estimated correspond to the cumulative response of GDP divided by the cumulative government spending over a given horizon.

In Annex E, we undertake some robustness checks around the baseline specification. More specifically, we consider two alternative model specifications: one in which the real effective exchange rate is removed from the regressions and another where the real effective exchange

rate is included in levels rather than first differences. The main results still hold, with medium-term multipliers being substantially higher for capital expenditure relative to current expenditure. Moreover, impact multipliers continue to be statistically insignificant at the five percent level.

Overall, the results from both LP and VAR models point to higher multipliers for capital expenditure relative to current expenditure. One characteristic that might help explain this differential is that capital expenditure is to a large extent financed by external borrowing in Paraguay, therefore mitigating crowding-out effects. Interestingly, we also find that, from a cyclical perspective, the correlation between the cyclical component of capital expenditure and the cyclical component of output (obtained through the HP filter) is negative and statistically significant at around -0.3 for the period 2003-2015 (Figure 4). This suggests that capital expenditure has behaved in a countercyclical manner. Nevertheless, the negative correlation discussed previously is not statistically significant for the entire sample period (1998-2015). These results are in line with the conclusions of Correa, Colman, and Tello (2016), who find that fiscal policy has been countercyclical in the more recent period.

Figure 4. Correlation between cyclical component of output and capital expenditure

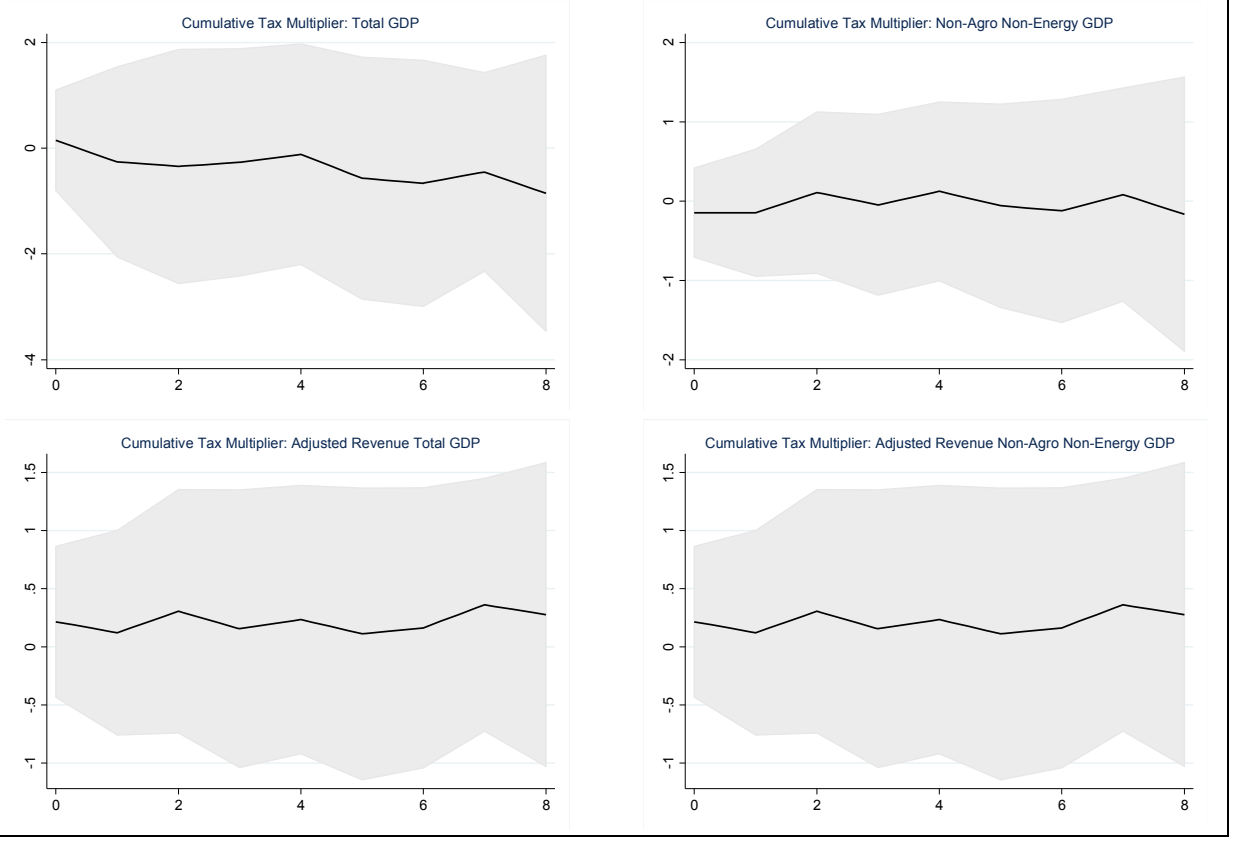


Furthermore, we also use the LP method to obtain estimates of tax multipliers (Figure 5). As in the previous section, we consider two types of tax shocks. The first shock is built from the residuals from a regression of real tax revenue on lagged tax revenue; contemporaneous and lagged government expenditures; contemporaneous and lagged GDP; lagged changes in the real effective exchange rate; and a deterministic trend. The second shock follows a similar approach but uses cyclically adjusted revenues rather than real tax revenues. Similarly, to the case of government expenditures, multipliers are calculated as the cumulative response of GDP divided by the cumulative tax revenue over a given horizon.

In the case of Paraguay, our estimated multipliers are not statistically significant at conventional levels in all cases. This contrasts with the results from VAR models for non-

agriculture and non-energy GDP, where we found negative and significant multipliers at longer horizons, but is in line with VAR results for total GDP. Ramey (2016) presents estimates using the LP method for the US that point to tax multipliers between -2 and -3, following a variety of identification approaches, including narrative methods. Moreover, the robustness checks presented in Annex E confirm the finding that tax multipliers in Paraguay are not significant both from an economic and statistical perspective.

Figure 5. Cumulative Tax Multipliers using the LP Method



Shaded area represents 95 percent confidence interval (HAC standard error bands). Sample period 1998:Q1-2015:Q2. Multipliers estimated correspond to the cumulative response of GDP divided by the cumulative tax revenue over a given horizon.

IV. Further Attempts to Address the Identification Problem

In order to obtain reliable estimates of fiscal multipliers it is crucial that the measures of tax and spending shocks used truly reflect discretionary policy changes that are unrelated to output fluctuations. So far in the paper, spending and tax shocks have essentially been identified through timing restrictions and exogenous assumptions. We try to further address the identification issue firstly by replicating the strategy of Kraay (2014) and using predicted disbursements by official creditors to identify exogenous government spending shocks, obtaining estimates of multipliers using an instrumental variable approach. Subsequently, we focus on the tax side and use a narrative approach as in Romer and Romer (2010) to identify exogenous tax shocks.

A. Identifying Spending Shocks through Disbursements by Official Creditors

In this sub-section, we replicate the approach proposed by Kraay (2014) to empirically estimate government spending multipliers. Kraay uses predicted disbursements by official creditors (multilateral banks and bilateral development agencies) to isolate the source of variation in government spending that is uncorrelated with contemporaneous macroeconomic shocks. More specifically, this author uses the timing between project approval and eventual disbursements to obtain the predetermined component of public spending in developing countries (the sample comprises 102 countries in the period 1970-2010 in the original paper). This identification strategy would work well if official creditors are a significant source of financing for government expenditures and if loan disbursements follow a schedule specified at the time of loan approval that is uncorrelated with subsequent macroeconomic shocks.

Kraay's dataset contains annual data for Paraguay covering the period 1972-2010. Disbursements by official creditors represent 13.7 percent of total government spending in Paraguay over the period compared to an average of 13.4 percent for the entire sample of countries. In Table 3, we replicate the baseline regressions presented in Kraay (2014). OLS and Two-Stage Least Squares point estimates of the multiplier range from 0.2 to 0.6, but none of the coefficients are statistically significant at conventional levels, even after weak-instrument-consistent confidence intervals are constructed. In fact, the first stage regressions (specifications 2 and 3) point to a weak link between predicted disbursements and government expenditures in Paraguay.

Table 3. Spending Multipliers using Kraay's (2014) Identification Strategy

	1	2	3	4	5
	OLS	OLS	OLS	IV	IV
	Δ Real GDP	Δ Government Exp.	Δ Government Exp.	Δ Real GDP	Δ Real GDP
Δ Government expenditure	0.393			0.594	0.180
	(0.435)			(2.398)	(8.649)
Δ in total predicted disbursements		0.280			
		(0.301)			
Δ predicted disbursements excluding loans approved in same year			0.171		
			(0.482)		
Constant	0.0401***	0.00804***	0.00813***	0.0385*	0.0419
	(0.00718)	(0.00267)	(0.00277)	(0.0212)	(0.0690)
Observations	38	38	38	38	38
R-sq	0.020	0.021	0.002	0.014	0.014

Heteroskedasticity-consistent standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

B. Identifying Tax Shocks in Paraguay through the Narrative Approach

As discussed in previous sections, Riera-Crichton, Vegh, & Vuletin, (2016) favor the use of statutory tax rates as a measure of tax policy. Nevertheless, the estimation of multipliers identified through changes in statutory rates is likely to be difficult in the case of Paraguay because of the small number of instances of changes in tax rates over the sample period. In fact, Vegh and Vuletin (2015) only include four changes in tax rates in Paraguay in their dataset covering the period 1979-2013: the introduction of the VAT in 1991, a reduction in

corporate taxes from 30 to 20 percent in 2005 and from 20 to 10 percent in 2006, and the introduction of the personal income tax of 10 percent in 2007.[4] In addition, statutory tax rates might not be a good proxy for tax policy for a number of reasons, such as changes in coverage over time (for example, the elimination of VAT exemptions or reduced rates for certain products), tax administrations issues, among other concerns.

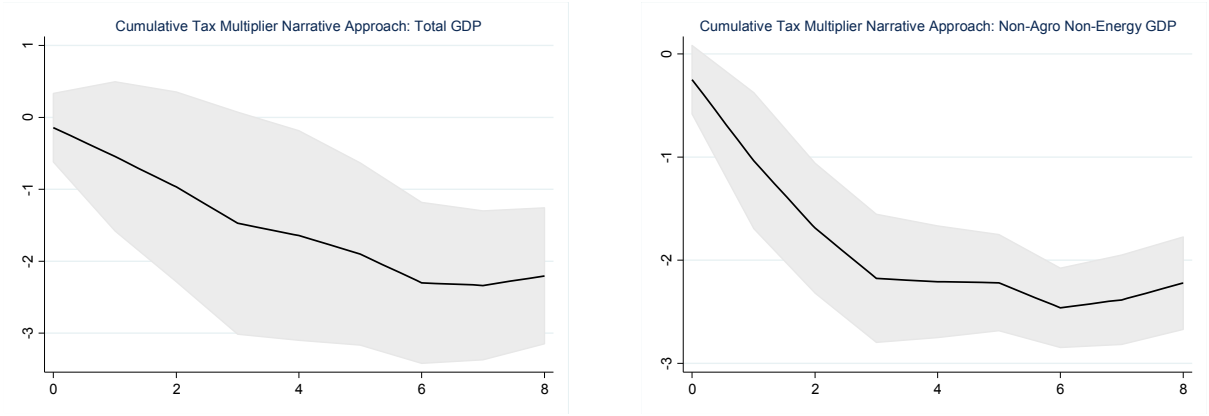
Therefore, we opted to follow an alternative strategy in this section and adopt the methodology proposed by Romer and Romer (2010) to create a "narrative" measure of exogenous fiscal shocks based on the estimated impact of policy changes. Annex F presents a detailed description of the shocks identified and the relevant sources (mainly IMF staff reports on Paraguay). Following Romer and Romer (ibid.) we consider four main types of motivation for fiscal policy changes. "Spending Driven" tax changes are motivated by a change in government spending (within the same year), a typical example would be a tax increase because the country is fighting a war. These are typically endogenous to output and therefore are not included in the regressions. "Countercyclical Action" are tax changes designed to return output growth to normal (close the output gap) and are by definition endogenous to the cycle. "Deficit Driven" tax changes refer essentially to tax increases designed to reduce an inherited budget deficit. These are discretionary fiscal policy changes not linked to the cycle and are included as exogenous shocks. Finally, there can also be exogenous tax changes motivated by a desire to raise long-run growth (potential output).

As far as the timing of the shocks is concerned, we consider the effects of tax changes at the time of implementation as in Romer and Romer (2010). We follow the convention that if a tax change occurs before the mid-point of the quarter, it is assigned to that quarter, otherwise it is assigned to next quarter. Therefore, one important aspect to consider is that we are measuring the effect of "anticipated" tax changes, which can differ significantly from the effect of unanticipated changes both empirically and in theory, as discussed in Ramey (2016). We are able to identify 11 instances of "tax shocks" in this way over the period 2001-2015 with most shocks being positive ones (aiming at increasing revenues). The size of the tax shocks is based on estimates of the revenue impact of the given tax policy measure at the time of implementation (expressed in annual terms) and at the prevailing level of GDP. This measure is then converted to local currency units in real terms (deflated by the GDP deflator) as appropriate for the regressions.

Figure 6 depicts estimates of tax multipliers obtained under the narrative identification strategy at different horizons using the LP method for total GDP and for non-agro non-energy GDP. In both cases, the point estimates obtained are much higher than the ones found under the alternative identification approaches. Impact multipliers are -0.1 and -0.2 for total and non-agro non-energy GDP, respectively, although only the latter is (marginally) significantly different from zero. Over the medium-term cumulative multipliers are in the order of -2, which is in line with the estimates of Gunter, Riera-Crichton, Vegh & Vuletin (2016) using the narrative approach for a larger set of countries and also similar to the results discussed in Ramey (2016) for advanced economies.

[4] As shown in Annex F, the personal income tax was only effectively implemented in 2012.

Figure 6. Multipliers using Narrative Tax Shocks and the LP Method

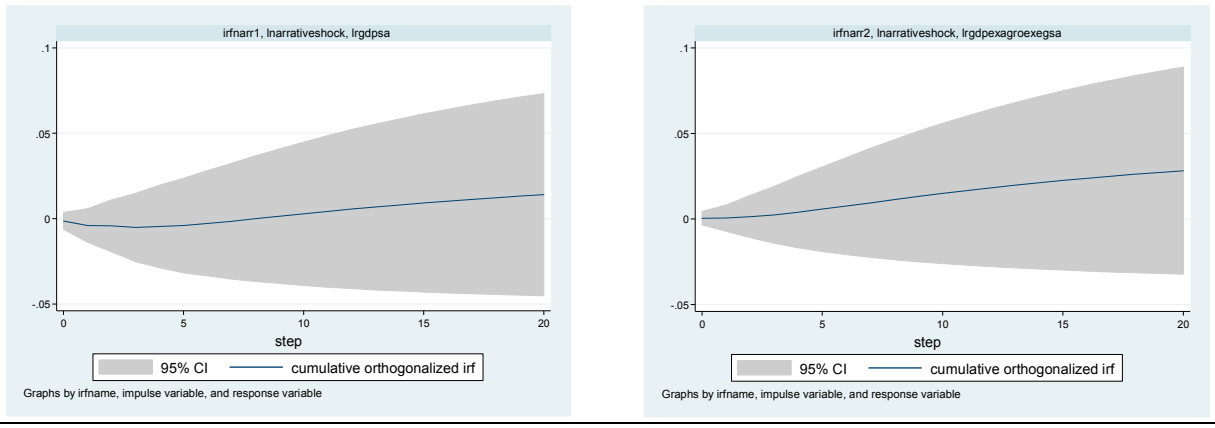


Shaded area represents 95 percent confidence interval (HAC standard error bands). Sample period 1998:Q1-2015:Q2.

Nevertheless, these results on tax multipliers should be taken with caution. In fact, when including the narrative tax shock in conventional VAR models, the impulse responses point to multipliers that are not statistically significant, undermining the robustness of the estimates obtained under the LP method (Figure 7).

Figure 7. Cumulative Orthogonalized Impulse Responses to Narrative Tax Shocks

Response of total GDP to Tax Shock *Response of non-agro non-energy GDP to Tax Shock*



Bootstrapped standard errors (500 repetitions). Shaded area represents 95 percent confidence interval. Sample period 1998:Q1-2015:Q2. Lag length selection based on AIC, SBC, and LR test. Higher order VAR used when conflicting results were obtained.

V. CONCLUSIONS AND POLICY IMPLICATIONS

Our results point to multipliers for current expenditure that are substantially lower than multipliers for capital expenditure in Paraguay. Medium-term multipliers for capital expenditure range from 0.4 to 2, whilst multipliers for current expenditure range from 0.1 to 0.9. One characteristic that might help explain this differences is that capital expenditure is to a large extent financed by external borrowing in Paraguay, therefore mitigating crowding-out effects. These differences and the fact that estimated multipliers for current expenditure are frequently close to zero in magnitude support recent IMF policy advice to contain growth in current primary expenditure while preserving capital expenditure.

In addition, when conventional identification approaches are used, the results suggest that tax multipliers are low relative to other countries and seem to affect non-agro non-energy GDP more prominently. Estimates of tax multipliers range from 0 to -0.4 over the medium-term. Nevertheless, when we consider exogenous tax shocks under the narrative approach, estimates of multipliers can reach -2, which is more in line with the international evidence (Gunter, Riera-Crichton, Vegh & Vuletin, 2016). Nevertheless, this larger estimate does not seem to be robust to different econometric estimation techniques.

Overall, the challenge to identify fiscal shocks in a satisfactory way remains open and therefore the estimates of expenditure and tax multipliers presented in this paper should be taken with caution. Bearing these caveats in mind, one implication of the results seems to be that the "balanced budget" multiplier for Paraguay i.e. the effect of on output of an increase in expenditures (in particular capital expenditure) financed by taxes is likely to be positive. We also discussed evidence indicating that capital expenditure behaved in a countercyclical manner in Paraguay, particularly over the 2003-2015 period and might have been used effectively as a stabilization tool with the execution of expenditures being accelerated during downturns and restrained during the expansionary phases of the cycle.

Annex A. Selected Recent Studies on Fiscal Multipliers

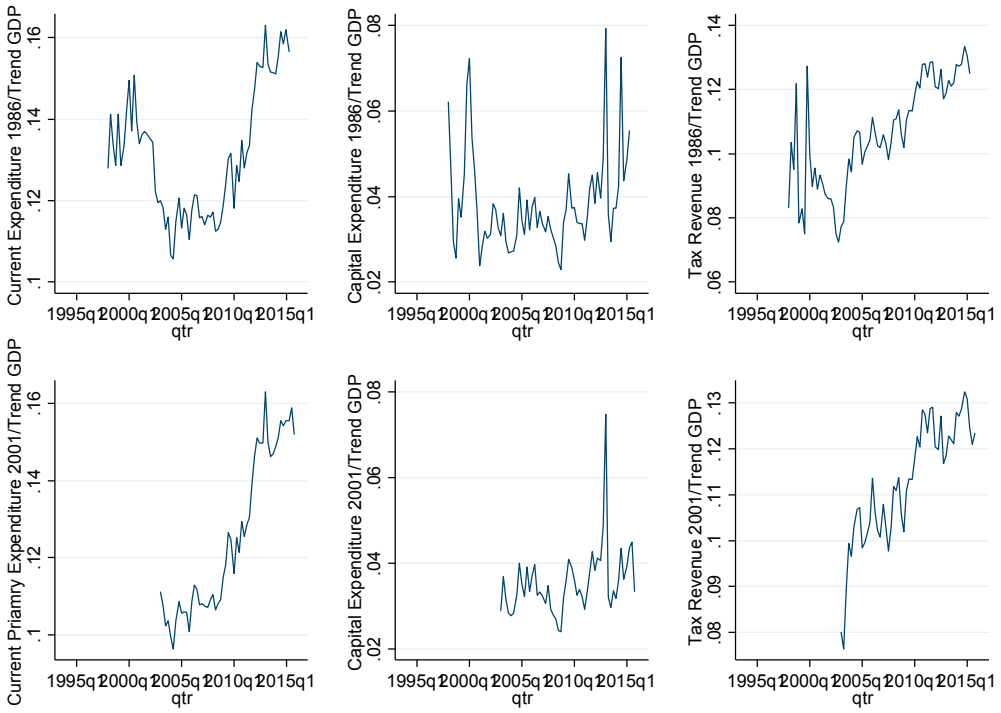
Study	Country Coverage	Estimates of Multipliers	Methodology
Ilzetzki, Mendoza & Vegh (2013)	44 countries (24 developing)	**0** for government consumption in dev. countries (on impact and cumulative). **1.6** for government investment in dev. countries (**0.6** on impact). **1.4** in the long-run for fixed exchange rate regime; **-0.7** for flexible regime. **-0.5** for open economies; **1.1** for closed economies (**0.6** on impact). **-3** in the long-run for high debt countries.	Panel VARs. Quarterly frequency. Blanchard-Perotti identification.
Kraay (2014)	102 developing countries	Around **0.4** for 1 year spending multiplier. Around **0.6** for 2-year **cumulative** multiplier.	IV regressions and Local Projection Method (LPM). Annual frequency. Identification through projected disbursements by official creditors.
Riera-Crichton, Vegh & Vuletin (2016)	14 advanced countries	Tax multiplier of around **-0.7** on impact. Multiplier Reaches **-3.7** at longer horizons.	Panel FE regressions. Quarterly frequency (1980-2009). Identification based on changes in statutory VAT tax rates.
Gunter, Riera-Crichton, Vegh & Vuletin (2016)	51 countries (21 advanced, 30 developing)	**-1.2** on impact for exogenous tax changes both in developing and industrial countries. **Around -2** cumulative after two years. Non-linear effects: tax multiplier is close to zero for low levels of initial taxes, very negative at high tax levels. Multiplier is zero for small tax changes, becomes negative as size of tax change increases.	Panel LPM. Quarterly frequency (1970-2014). "Narrative Approach" based on expanded VAT tax rate database.

Study	Country Coverage	Estimates of Multipliers	Methodology
Estevao & Samake (2013)	7 Central American Countries	Ranging from **0 to 0.4** on impact for total expenditures (cumulative ranging from **0.4 to 0.9**). **0** on impact for taxes Ranging from **-0.2 to -1.1** cumulative for taxes.	Vector error correction models. Annual frequency. Identification: structural restrictions and co-integration.
Ramey & Zubairy (2015)	Canada	**0.5** government spending in linear model. **>1** cumulative for periods of high unemployment. **<0.5** cumulative for periods of low unemployment.	LPM with state dependent multiplier. Quarterly frequency. Identification based on defense spending.
Ramey & Zubairy (2016)	United States	**0.7** cumulative multiplier over 2 years for linear model. No evidence of significantly different multipliers across states of slack in the economy.	LPM with state dependent multiplier and other methods. Quarterly frequency. Identification based on defense spending and Blanchard-Perotti shocks.
Matheson & Pereira (2016)	Brazil	**0.5** on impact for spending multiplier. Around **0** for cumulative multiplier after 2 years. **0.5** on impact for revenue multiplier (tax cut). Around **2** for accumulated revenue multiplier.	Structural VAR. Quarterly frequency. Blanchard-Perotti identification for expenditures (but not revenue).
Valencia (2016)	Mexican States	Between **0.5-0.6** on impact spending multiplier **0.7** cumulative multiplier. Around **1** on impact multiplier with <0 output gap.	Panel regressions (FE, GMM). Annual frequency. Simultaneity addressed by using lagged values as instruments.
Vtyurina & Leal (2016)	Peru	**0** for current expenditure. **1.1** for capital expenditure in lower growth regime (**0.5** on impact). **0.5** for capital expenditure in high growth regime.	Threshold VAR (high growth and low growth regime). Quarterly Frequency. Identification: fiscal variables ordered first in the VAR.

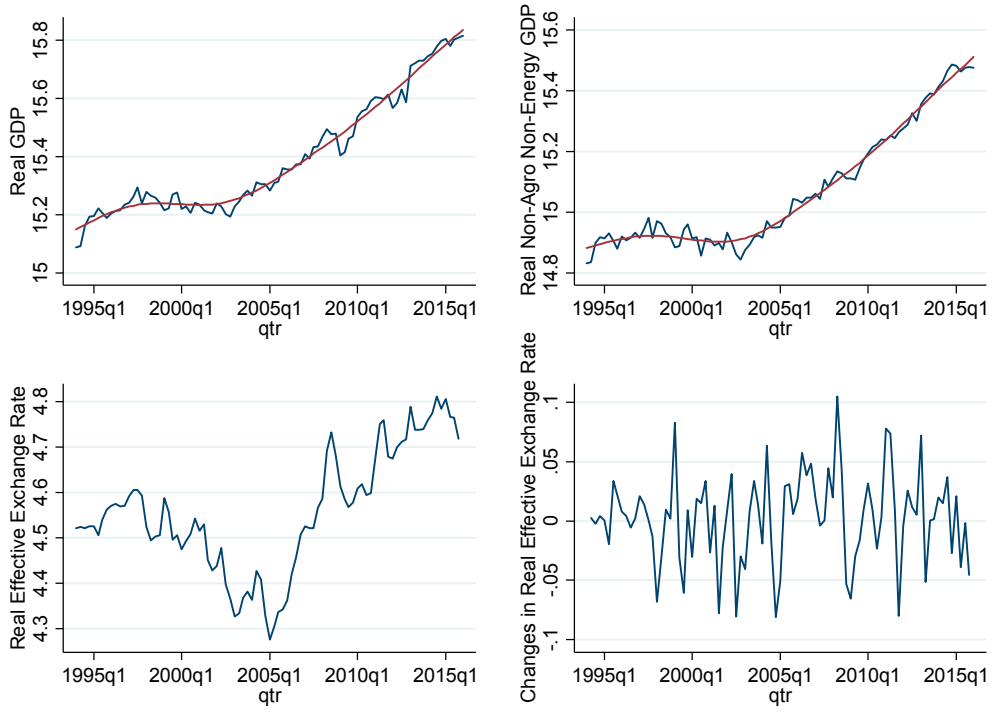
Annex B. Variable Definitions and Sources

Variables	Definition	Source
Quarterly Real GDP, Real Non-Agro Non-Energy GDP, GDP Deflator	1994 base year. Data availability, 1994:Q1 to 2016:Q1. Non-Agro Non-Energy GDP is given by total GDP excluding agriculture and binationals. GDP seasonally adjusted (X-12 method) and transformed to logs in VAR models.	Haver, Central Bank of Paraguay.
Real Effective Exchange Rate	Based on CPI indexes. 2010=100. Log differences included in regressions.	IMF/INS
Current and Capital Expenditures, Tax Revenues. 1986 GFSM definitions	Central government. In millions of Guaranies. Data availability 1998:Q1-2015:Q2. All variables deflated by the GDP deflator, seasonally adjusted (X-12) and transformed to logs in VAR models. Variables normalized by trend GDP (HP filter) in LP models.	Haver, Central Bank of Paraguay.
Current Primary and Capital Expenditures, Tax Revenues. 2001 GFSM definitions	Central government. In millions of Guaranies. Data availability 2003:Q1-2016:Q1. All variables deflated by the GDP deflator, seasonally adjusted (X-12) and transformed to logs in VAR models. Variables normalized by trend GDP (HP filter) in LP models.	Situación Financiera Administración Central, Ministry of Finance, Paraguay
Predicted Disbursements by Official Creditors. Annual Real GDP, Annual Government Expenditures.	Annual data 1972-2010. Predicted disbursements based on loans recorded in World Bank's Debtor Reporting System database. Real GDP from World Bank's WDI. Government Expenditure from IMF's WEO database and other sources.	Kraay (2014)

Fiscal Variables Normalized by Trend GDP



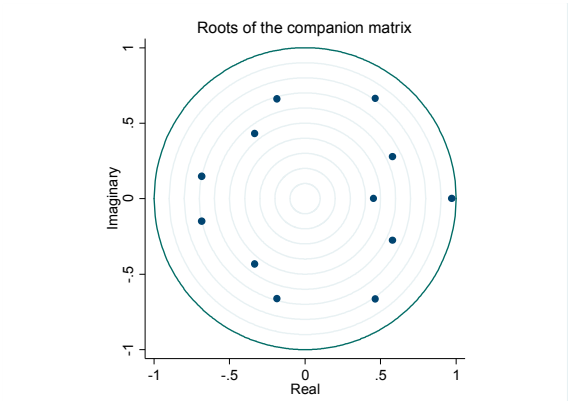
Real GDP, Non-Agro Non-Energy GDP and Real Effective Exchange Rate



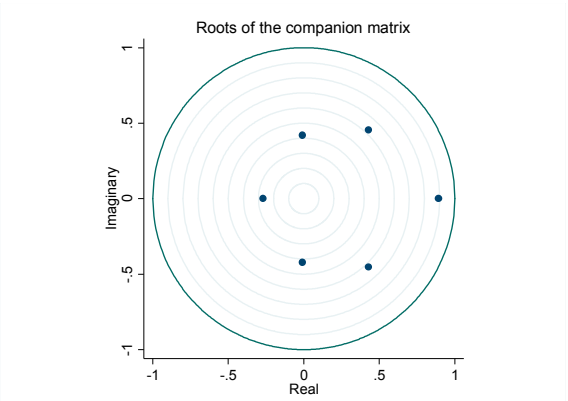
Annex C. VAR Stability Checks

Stability Checks for VARs used for Government Spending Multipliers

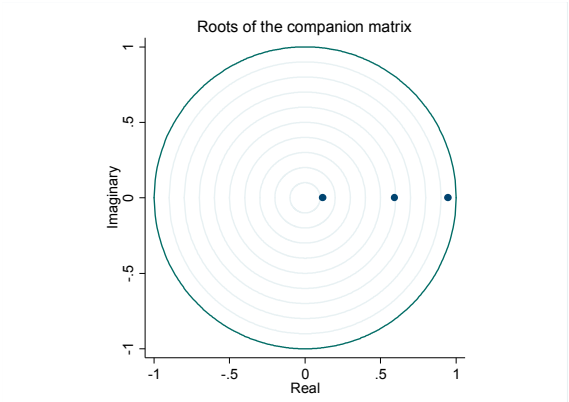
Model with current expenditure and total GDP



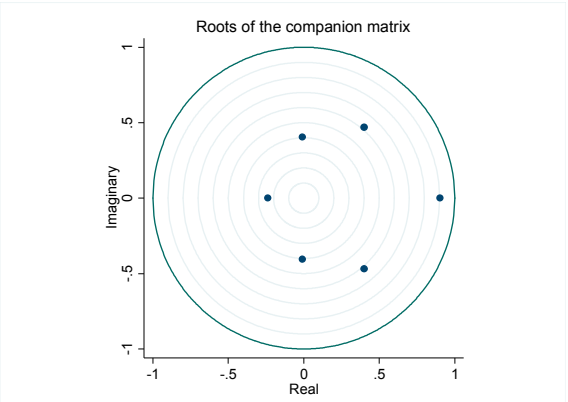
Model with capital expenditure and total GDP



Model with current expenditure and non-agro non-energy GDP

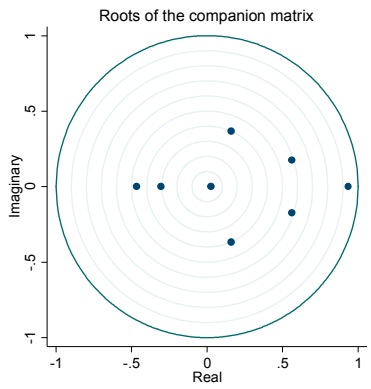


Model with capital expenditure and non-agro non-energy GDP

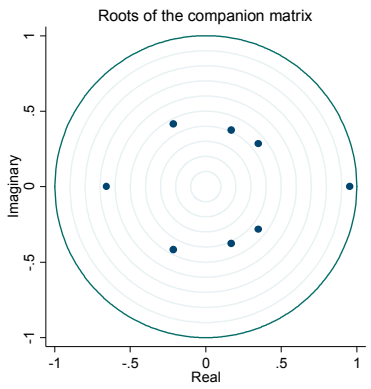


Stability Checks for VARs used for Tax Multipliers

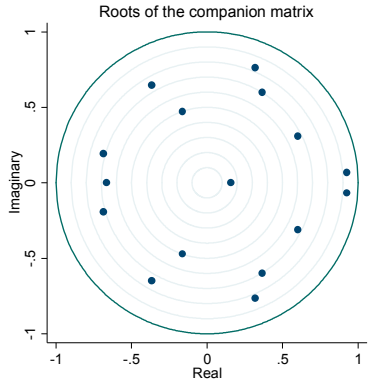
Model with Unadjusted tax revenue and total GDP



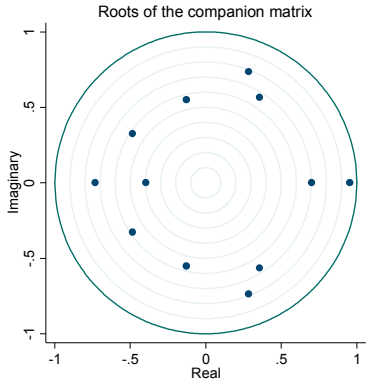
Model with cyclically adjusted revenue and total GDP



Model with Unadjusted tax revenue and non-agro non-energy GDP



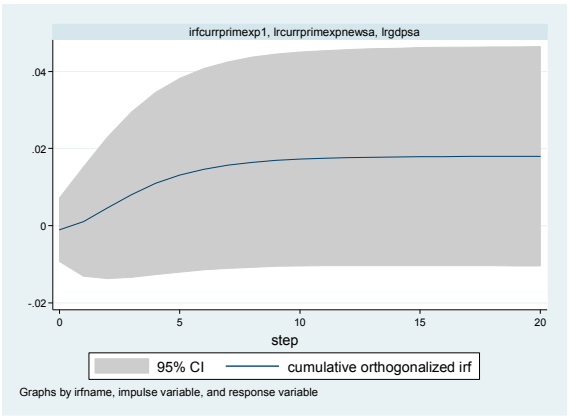
Model with cyclically adjusted revenue and non-agro non-energy GDP



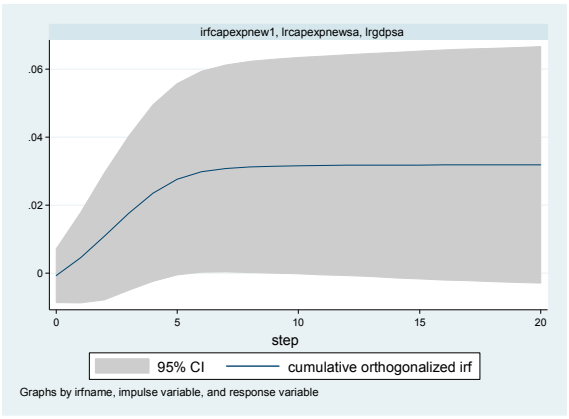
Annex D. Additional Results: Alternative Definition of Fiscal Variables

Annex Figure. Cumulative Orthogonalized Impulse Responses to Government Spending Shocks

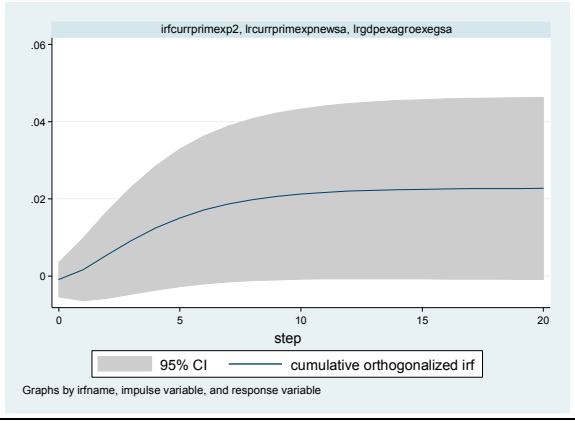
Response of total GDP to Current Primary Expenditure Shock



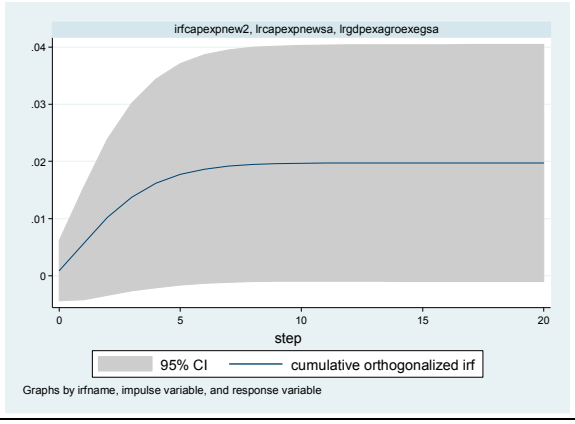
Response of total GDP to Capital Expenditure Shock



Response of non-Agro non-Energy GDP to Current Primary Expenditure Shock



Response of Non-Agro Non-Energy GDP to Capital Expenditure Shock



Bootstrapped standard errors (500 repetitions). Shaded area represents 95 percent confidence interval. Sample period 2003:Q1-2015:Q4. Lag length selection based on AIC, SBC, and LR test. Higher order VAR used when conflicting results were obtained.

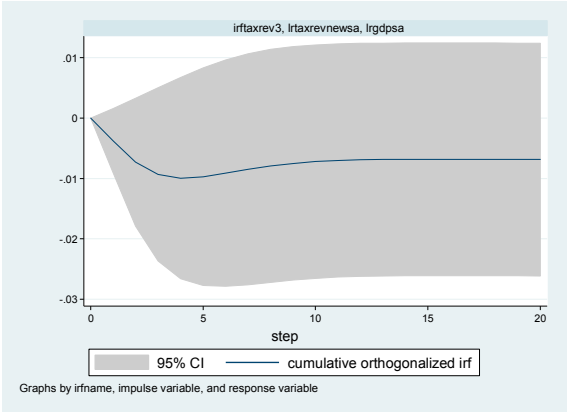
Annex Table. Estimates of Government Spending Multipliers in Paraguay (Cumulative)

	Total GDP	Non-Agro Non-Energy GDP
Current Primary Expenditure		
t=0	0.0	0.0
t=8	0.1	0.1**
t=20	0.1	0.1**
Capital Expenditure		
t=0	0.0	0.0
t=8	0.9**	0.4*
t=20	0.9**	0.4*

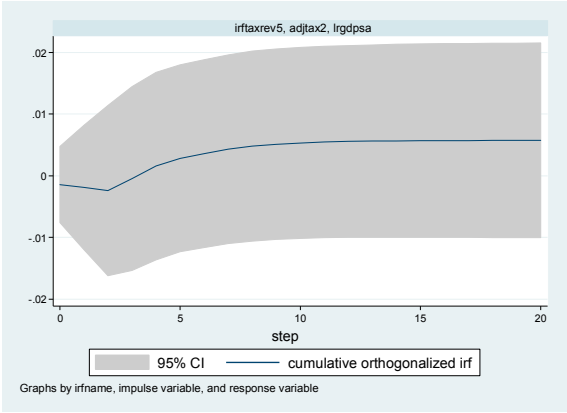
Note: ** indicates statistical significance at the 5 percent level. * indicates significance at the 10 percent level.

Annex Figure. Paraguay: Cumulative Orthogonalized Impulse Responses to Tax Shocks

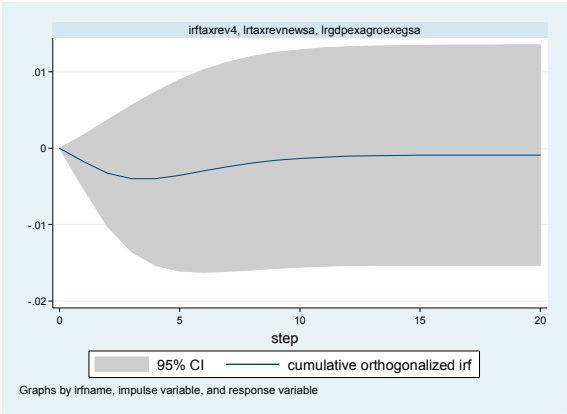
Response of total GDP to Tax Revenue Shock



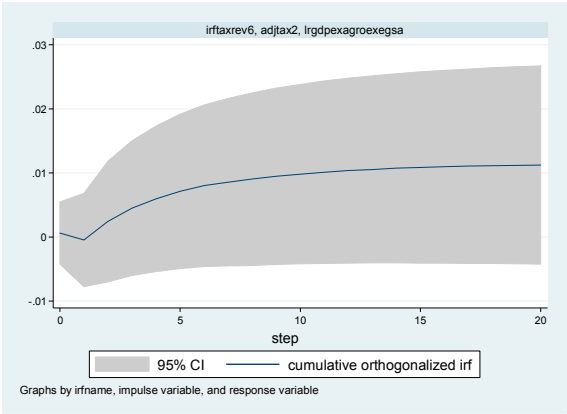
Response of total GDP to Cyclically Adjusted Revenue Shock



Response of non-Agro non-Energy GDP to Tax Revenue Shock



Response of Non-Agro Non-Energy GDP to Cyclically Adjusted Revenue Shock



Bootstrapped standard errors (500 repetitions). Shaded area represents 95 percent confidence interval. Sample period 2003:Q1-2015:Q4. Lag length selection based on AIC, SBC, and LR test. Higher order VAR used when conflicting results were obtained.

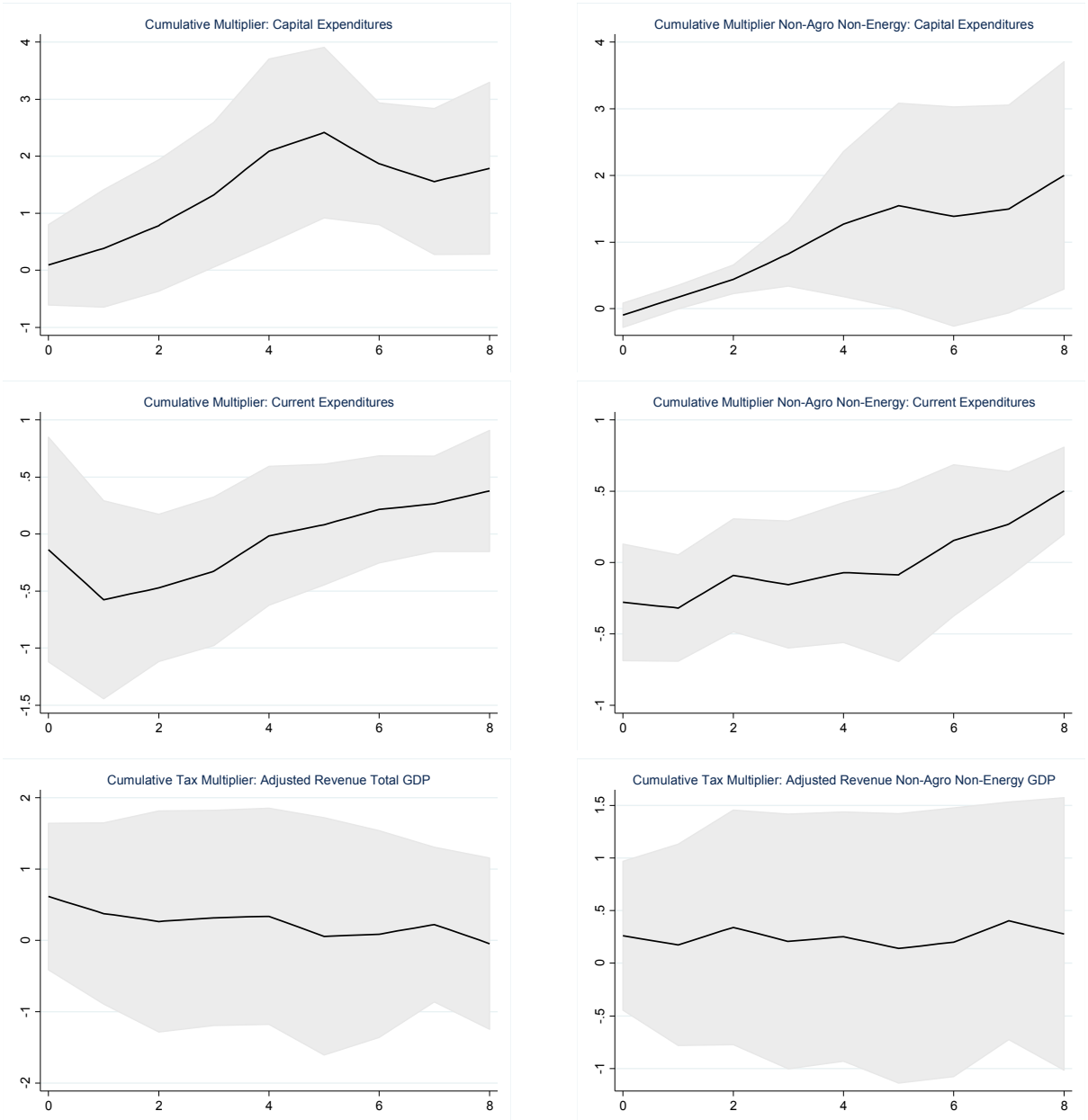
Annex Table. Estimates of Tax Multipliers in Paraguay (Cumulative)

	Total GDP	Non-Agro Non-Energy GDP
Real Tax Revenue		
t=0	0.0	0.0
t=8	-0.1	0.0
t=20	-0.1	0.0
Cyclically Adjusted Tax Revenue		
t=0	0.0	0.0
t=8	0.0	0.1
t=20	0.1	0.1

Note: ** indicates statistical significance at the 5 percent level. * indicates significance at the 10 percent level.

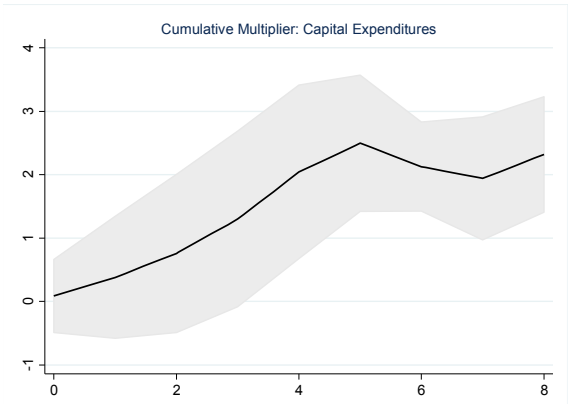
Annex E. Additional Results: Variations in Model Specification

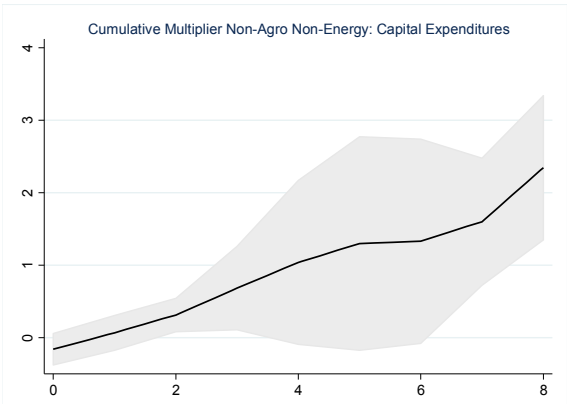
Annex Figure. Cumulative Multipliers using the LP Method (Real Exchange Rate Excluded)

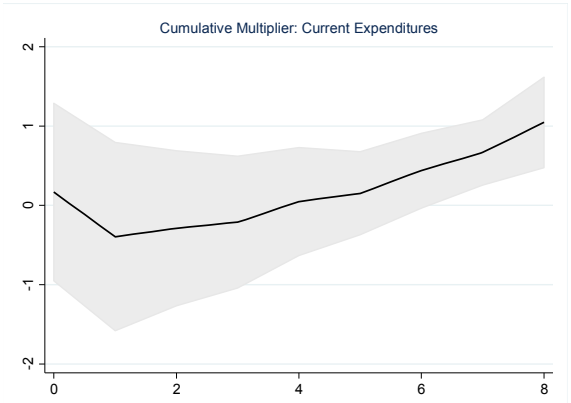


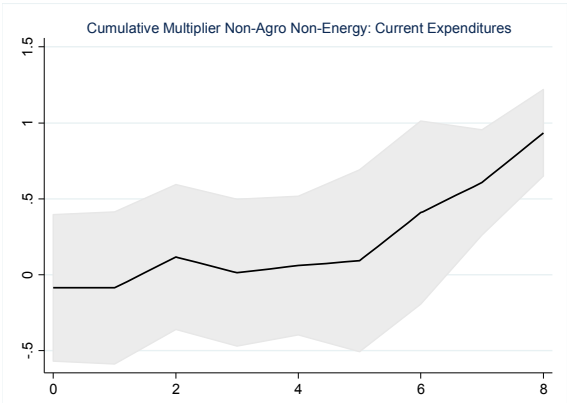
Shaded area represents 95 percent confidence interval (HAC standard error bands). Sample period 1998:Q1-2015:Q2. Multipliers estimated correspond to the cumulative response of GDP divided by the cumulative government expenditure or tax revenue over a given horizon.

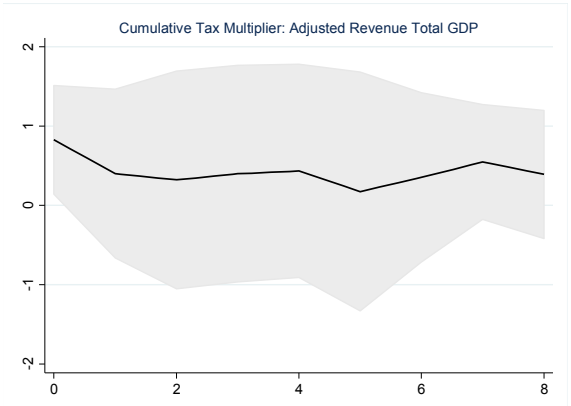
Annex Figure. Cumulative Multipliers using the LP Method (Real Exchange Rate in Levels)

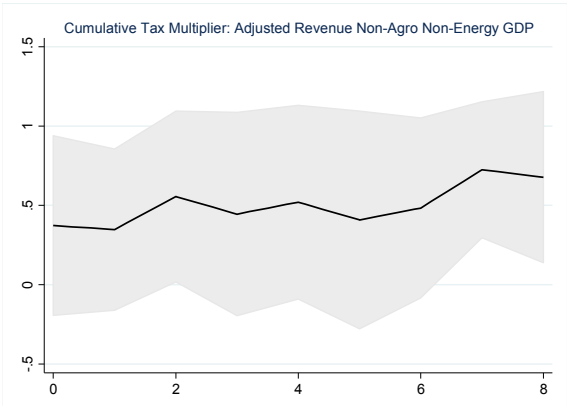












Shaded area represents 95 percent confidence interval (HAC standard error bands). Sample period 1998:Q1-2015:Q2. Multipliers estimated correspond to the cumulative response of GDP divided by the cumulative government expenditure or tax revenue over a given horizon.

Annex F. Narrative Exogenous Tax Shocks

Year	Description	Timing	Size	Motivation	Source
2001	Increase in excise tax on diesel. Inclusion of transfers and personal services in VAT tax base.	Q1 (report refers to measures of late 2000 early 2001).	0.5 percent of GDP	DD	IMF Country report 01/87. Page 10
2003	Overhaul of tax and customs administration.	Q1 (report mentions improvements in the first 3 months).	0.9 percent of GDP	DD	IMF Country Report 04/66 . Page 8 and Box 1.
2003	Increase in the excise tax on diesel fuel (6 percentage point hike).	Q3 (August).	0.5 percent of GDP	DD	IMF Country Report 04/66 . Page 8.
2004	Increase in the excise tax on diesel fuel (6 percentage point hike).	Q1 (January)	0.25 percent of GDP	DD	IMF Country Report 04/294, page 7
2004	Temporary export tax on soy.	Q1 (February)	0.2 percent of GDP	DD	IMF Country Report 04/294, page 7
2004	Tax reform. The law eliminates most exemptions to the corporate income tax while reducing rates, broadens the base of the VAT, institutes a new personal income tax , and institutes a new agricultural income tax to replace the IMAGRO tax.	Q3 (approved on June 25).	0.1 percent on GDP, estimated effect in 2004.	DD/LR	IMF Country Report 05/59, page 13, page 25, page 43. Table 16.
2005	Elimination of temporary export tax on soy.	Q1 (February)	-0.2 percent of GDP.	LR	IMF Country Report 06/30, page 11, footnote 7.
2005	Reduction in corporate income tax rate. From 30 to 20 percent	Q3 (August).	-0.4 percent of GDP	LR	IMF Country Report 06/100, page 5. Annual impact estimated in IMF Country Report 05/59 Table 16.
2006	Reduction in corporate income tax rate. From 20 to 10 percent	Q3 (August).	-0.7 or -1.2 percent of GDP in 2006	LR	IMF Country Report 05/59 Table 16. Footnote 2 of IMF Country Report 06/100, page 5, estimates higher impact at 1.2 percent of GDP.
2012	Introduction of personal income tax (10 percent rate)	Q3 (August)	Original estimate between 0.2 to 0.3 percent of GDP. 2014 estimate is 0.1 percent of GDP.	DD/LR	IMF Country Report 10/170, page 19. IMF Country Report 14/60, Page 7 and Table 1.
2014	IRAGRO and Agricultural VAT. Revamped tax on agricultural income	Q1 (January)	0.23 percent of GDP	DD/LR	IMF Country Report 14/60, Page 7 and IMF staff estimate in country framework.

DD= A deficit-driven tax change is a tax increase designed to reduce an inherited budget deficit. Exogenous to output. LR =A long-run tax change is one aimed at raising long-run growth. Exogenous to cyclical considerations. Methodology to identify tax shocks follows Romer and Romer (2010).

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