EVALUATION OF THE EFFECTS OF FISCAL POLICY IN ECUADOR USING STRUCTURAL VECTOR AUTOREGRESSIONS

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Abstract - This paper estimates the macroeconomic effects of fiscal policy and oil revenues for Ecuador using structural vector autoregression techniques. We characterize the effects of taxes, government consumption, government investment, and oil revenues. The results show that an expansionary shock to government investment increases output in a similar amount than a reduction in taxes, but lower than the effect of a shock to oil revenues of the same magnitude. The Ecuadorian economy evidences a high level of pass-through from oil revenue shocks, which makes it vulnerable to oil price fluctuations.

I. INTRODUCTION

Ever since Ecuador adopted a dollarized monetary system in 2000, fiscal policy became the main policy tool to affect aggregate demand both in the short and the long run. We explore the effects of fiscal policy on economic activity through the lens of a vector autoregressive model in which we include oil revenues, which represent 35 percent of fiscal revenues, on average, during 2000-2014.

Given that Ecuador is a small oil exporting country, we assume that unexpected variations in oil revenues are exogenous to the economy. Taking advantage of this feature, we specify a vector autoregressive model that includes real GDP, tax revenues, government consumption, government investment, and oil revenues. Then, we follow the identification scheme by Blanchard and Perotti (2002) to determine the economic causality channels of the fiscal policy variables.

The main results show that a shock that increases tax revenues implies a reduction of real GDP as well as a perturbation that increases government consumption. The effect of government investment on output indicates an increase of similar magnitude of a reduction in tax revenues. Finally, oil revenues have statistically significant effects on all the variables of the system, which evidences how vulnerable the Ecuadorian economy is to oil price fluctuations. In particular, the largest effect on real GDP comes from oil revenue shocks as opposed than from fiscal policy variables.

II. VARIABLE CONSTRUCTION

This paper considers revenues (oil and tax) and spending (consumption and investment) of the general government, including local governments and public companies. The frequency is quarterly and covers the first quarter of 2002 to the third quarter of 2016. The information is obtained from the Central Bank of Ecuador.

As mentioned before, the Ecuadorian economy was dollarized in 2000. To keep tractability of the data, we focus on the post-dollarization period. Additionally, we start in the year 2002 to avoid using data on inflation that was converging towards the level consistent with dollarization after reaching annualized inflation of above 30 percent, on average, in 2000 and almost 20 percent in 2001.

Oil revenues are received by the general government as part of the production and exports of its oil company (EP-PETROECUADOR) and as royalties through the different contracts with private oil companies.[1] There are at least two reasons to use oil revenues instead of the oil price. The first is that oil revenues allow an easier interpretation of the policy scenarios, in particular, the computation of fiscal multipliers and counterfactuals about deficit financing options. The second is that oil revenues reflect changes that have occurred in oil production, like the implementation of the new pipeline, and with contracts between private companies and the government, both of which could have effects on the fiscal variables and on economic activity. In any case, as a robustness check, we also use the price of oil in our econometric specification.

[1] Ecuador does not have the capacity to refine oil to obtain oil-derived products by itself and has to import them. Of the domestic consumption, 13 percent was imported in 2000. In 2015, 45 percent of the domestic consumption was imported. The information on oil revenues we use is net of the cost of oil-derived imports.

We use net tax revenues as the other income fiscal variable. They are basically defined as tax revenues minus transfers (including social security). Consumption spending is defined as the expenses in government wages and purchases of goods and services. Capital spending, in turn, is the expense in gross capital formation of the central government plus transfers to the rest of government entities for investment purposes.

III. VECTOR AUTOREGRESSIVE (VAR) MODEL SPECIFICATION AND ESTIMATION

The VAR model includes six variables (all in logs): (i) GDP per capita (y_t), (ii) non-oil sector GDP deflator (p_t), (iii) government consumption per capita (g_t), (iv) government investment per capita (k_t), (v) net tax revenues per capita (τ_t), (vi) oil revenues per capita (o_t).

Let $\mathbf{Y}_t$ the vector that includes the variables described above, $\mathbf{U}_t$ the vector of the reduced-form VAR residualsand $\mathbf{A(L)}$ a lag polynomial. The model in reduced form is defined by the following dynamic equation:

$$\mathbf{Y}_t = \mathbf{A(L)}\mathbf{Y}_{t-1} + \mathbf{U}_t \qquad (1)$$

The model (1) also includes a constant and a lineal trend term in each of the equations. A key assumption in the model is that oil revenues are strictly exogenous. This assumption is justified because Ecuador is a price-taker country in the world oil market.[2] Hence, we express model (1) as the following system of equations:

$$\begin{aligned} \mathbf{X}_t &= \mathbf{C(L)}o_{t-1} + \mathbf{D(L)}\mathbf{X}_{t-1} + \mathbf{V}_t \\ o_t &= B(L)o_{t-1} + u_t^o, \end{aligned}$$

where $\mathbf{X}_t \equiv [\tau_t, k_t, g_t, y_t, p_t]'$ and $\mathbf{V}_t \equiv [u_t^\tau, u_t^k, u_t^g, u_t^y, u_t^p]'$.

The Dickey-Fuller and Phillips-Perron nonstationarity tests yield mixed evidence about the presence of unit roots in the data. Additionally, we do not consider the possibility of cointegration relationships in the system. Consequently, based on the results of Sims, Stock and Watson (1990), we estimate the VAR model with the variables in levels. We choose two lags based on the Akaike, Schwarz, and Hannan-Quinn information criteria and the Lagrange multiplier test of white noise in the residuals.

3.1 Identification of Structural Shocks

The reduced-form VAR residuals, $\mathbf{U}_t$, do not have an economic interpretation because they are linear combinations of the structural shocks. Pieschacón (2012) uses the assumption of strict exogeneity of the oil price to achieve partial identification of the model. This procedure is adequate if one wants to estimate the effect of an oil price shock on the rest of the variables. However, in this paper, we aim to estimate not only the effect of oil revenues on economic activity, but also to determine the effects of tax revenues and government spending on GDP and inflation.

The identification strategy corresponds to the methodology in Blanchard and Perotti (2002). The relationship between the reduced-form VAR residuals, $\mathbf{U}_t$, and the structural shocks, denoted $\boldsymbol{\varepsilon}_t$, is given by the following equation:

$$\mathbf{A}U_t = \mathbf{B}\varepsilon_t,$$

where we assume that the structural shocks are independent and identically distributed with identity variance-covariance matrix.

[2] Even though the Ecuadorian oil production has increased from 143.8 million barrels in 2002 to 198.2 million barrels in 2015, which exhibits a trend, the short-run fluctuations in oil revenues are driven by variations in the oil price. Given the quarterly frequency of the data that reflects short-run variations and the exogeneity of the oil price, one can consider that oil revenues are exogenous.

It is important to remember that the assumption of strict exogeneity of oil revenues implies that the corresponding structural shock is already identified. That is, the residual of the oil revenues equation is proportional to the structural shock of said variable, as follows:

$$u_t^o = \beta_{o,o}\varepsilon_t^o,$$

where $\beta_{o,o}$ is the standard deviation of u_t^o.

The residuals u_t^τ, u_t^k y u_t^g are linear combinations of three types of shocks, according to Perotti (2002):[3]

1. The automatic response of taxes and government spending to changes in GDP, prices, and oil revenues, under current policy rules.
2. Whatever discretionary adjustment is done to fiscal policy in response to unexpected movements in GDP, prices, and oil revenues within the quarter.
3. Random shocks to fiscal policy. These are the structural shocks, ε_t, which we need to identify in order to obtain the impulse-response functions.

IV. EFFECTS OF FISCAL POLICY AND OIL REVENUES

The responses of fiscal variables to shocks on themselves and the oil price appears in Figure 1 while the responses on output and the price level appear in Figure 2.

4.1 Effects of Taxes

A one-dollar shock on taxes increases government consumption and investment in a similar way, although on average, the response of the government investment is higher, reaching 20 cents in the second quarter. The response of output indicates a decline of about 20 cents in the third quarter, while the effect on the price level is insignificant.

4.2 Effects of Government Consumption

A shock of one dollar on government consumption increases tax revenues, although the effect is

not statistically significant. The shock reduces government investment by about 40 cents in the second quarter. Government consumption also lowers real GDP by about 30 cents in the fourth quarter, and prices by about 0.2 percent at an annualized rate.

[3] In Perotti (2002), there are not oil revenues.

4.3 Effects of Government Investment

A shock of one dollar on government investment increases significantly tax revenues, which reach about 25 cents in the third quarter. Government consumption also increases, reaching about 12.5 cents in the third quarter. The effect on real GDP is expansionary, increasing output by about 20 cents in the second quarter after the shock. Prices also increase, with a response of about 0.1 percent by the sixth quarter.

4.4 Effects of Oil Revenues

An increase of one dollar on oil revenues increases tax revenues by about 15 cents in the eight quarter after the shock. Government consumption also increases, but by only 6 cents in the sixth quarter. The response of government investment is much more pronounced, reaching about 40 cents and much quicker, happening in the fourth quarter. Output has a hump-shaped response that reaches 30 cents by the sixth quarter. Lastly, prices increase by about 0.1 percent in the tenth quarter after the shock.

Conclusion

The aim of this paper was to estimate the effect of taxes, government consumption, government investment, and oil revenues (all of which are part of the fiscal policy of the Ecuadorian economy) on output. The results show that the most important variable for increasing real GDP is oil revenues. Unfortunately, oil revenues are exogenous to the Ecuadorian economy. Shielding the economy from the effects of oil price fluctuations would allow fiscal policy to have the countercyclical effects that are desirable. Future research can explore these avenues.

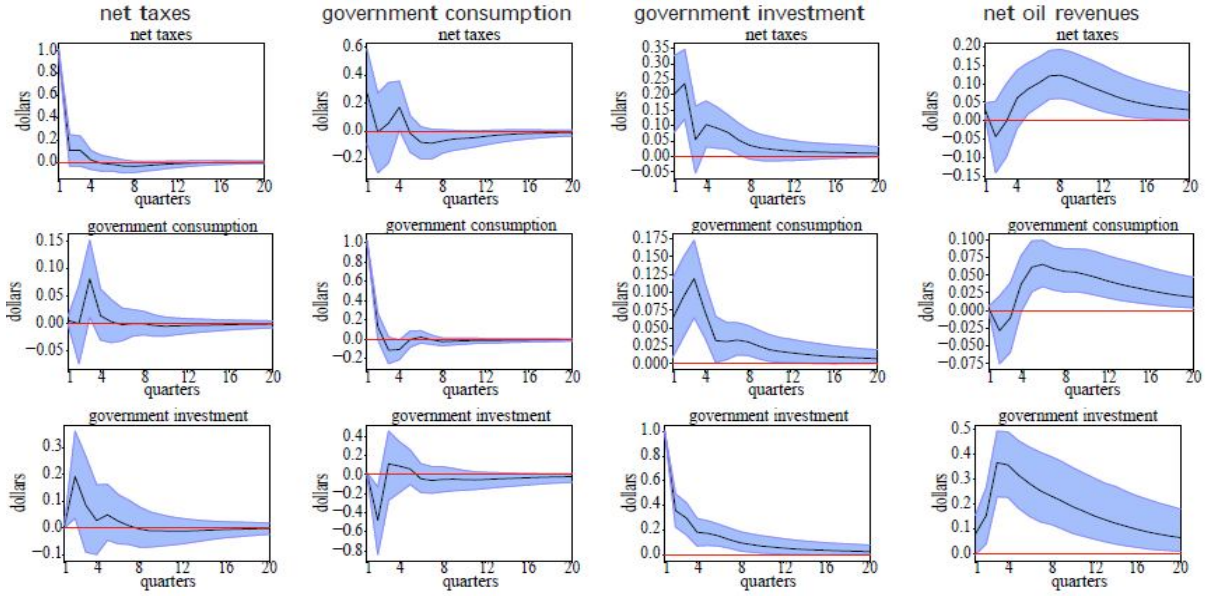


Figure 1: Response of fiscal variables to fiscal and oil shocks

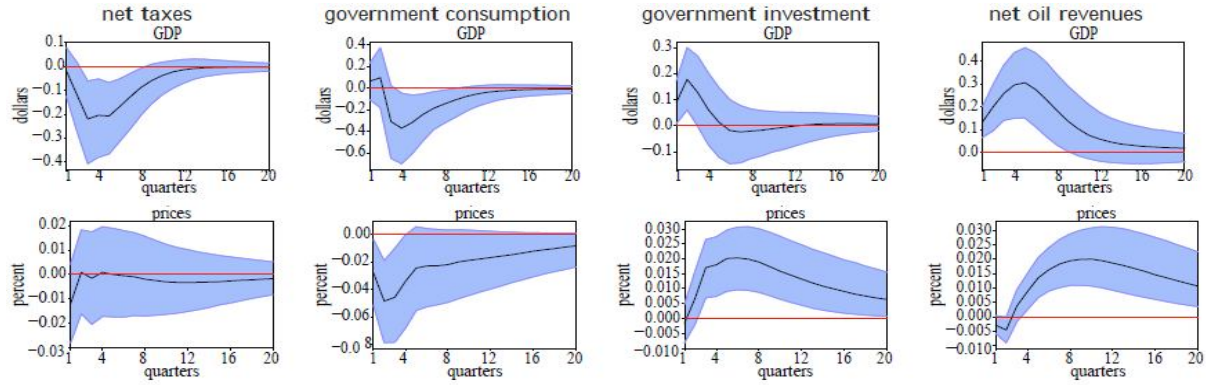


Figure 2: Response of GDP and prices to fiscal and oil shocks

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