Ensayos
sobre POLÍTICA ECONÓMICA

Nonlinear fiscal multipliers for public expenditure and taxes in Colombia

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Desafíos de la Política Fiscal frente a la Reciente Incertidumbre Macroeconómica

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Motivation

Batini, Eyraud, & Weber (2014) "A Simple Method to Compute Fiscal Multipliers" IMF, point:

- "The business cycle also affects the persistence and shape of fiscal multipliers. Fiscal shocks occurring in recessions or when production is below potential may have more persistent effects…"
- "The shape of multipliers also depends on the cyclical position: Auerbach and Gorodnichenko (2013) …"

Results

- We found effects significant multipliers.
- Multipliers change depending of the shock and the state of the economy.
- The size of tax and government expenditure multipliers are higher in recessions as compared to expansions.
- We do not found asymmetries.
- All multipliers stabilize after fourth quarter.
- Fiscal policy is transmitted relatively quickly and stabilizes after a short time.

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II. Model and data

III. Preliminary results

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I. Introduction

Definition of Fiscal Multipliers

It measures the change on product due to an exogen ous change in the government spending or tax revenue [Spilimbergo *et al* (2009)]

- Impact Multiplier: $\frac{\Delta Y(t)}{\Delta G(t)}$

- Accumulated Multiplier: $\sum_{j=0}^{T} \frac{\Delta Y(t+j)}{\Delta G(t)}$

I. Introduction (cont.)

Why is important to study Fiscal Multipliers?

- ✓ Government decisions have important effect on consumers and firms, in terms of income, consumption and investment.
- ✓ Important in developing economies.
- ✓ Macroeconomic forecast accuracy.
- ✓ Multipliers are among the factors that need to be considered in setting fiscal policy.

I. Introduction (cont.)

Why is important to study Fiscal Multipliers?

- ✓ Need for quantification that provides information of the impact that FP has when an intervention is performed, (multipliers: Public expenditure and tax revenue).

- ✓ Eyraud and Weber (2012): "…underestimation of multipliers lead to set unreachable targets, failing to calculate measures such as the necessary adjustment in the debt ratio. These constant failures may affect the trustworthiness of fiscal government programs."

I. Introduction (cont.)

Fiscal Multipliers and Economic Cycle

✓The business cycle affects the persistence and shape of fiscal multipliers.

✓Fiscal shocks occurring in recessions may have more persistent effects, because of hysteresis effects or because credit constrained agents cannot offset the reduction in their disposable income by borrowing.

✓The shape of multipliers also depends on the cyclical position: Auerbach and Gorodnichenko (2013) show that multipliers steadily increase if the initial spending shock occurs in a recession, while they steadily decline if the shock happens in an expansion.

I. Introduction (cont.)

Fiscal Multipliers and Economic Cycle

✓The non-linearity that can present the fiscal variables.

✓In the case of expenditure, when the economy is in recession effects like crowding out are attenuated, given that there is excess installed capacity, so the multiplier effect on aggregate demand may be different in expansion or recession.

✓On the tax side, when the economy is expanding, tax revenues such as income, VAT or in general taxes associated with consumption tend to be higher than when the economy is in recession, affecting not only the fiscal balance policy but also the public policies that can be made with that type of income.

I. Introduction (cont.)

Empirical Evidence in the Literature

The resulting multipliers tend to be heterogeneous across countries.

Autors	Results		Country	Metodology
Auerbach and Gorodnichenko (2012a), 6 quarters	**Spending** Expansion: 0 Linear: 0.9 Recession: 0.7	**Revenue** Expansion: NA Linear: NA Recession: NA	United States	STVAR
Auerbach and Gorodnichenko (2012b), OECD, first year	**Spending** Expansion: -0.2 Linear: 0.2 Recession: 0.5	**Revenue** Expansion: NA Linear: NA Recession: NA	OECD	STVAR
Batini and others (2012), 4 quarters	**Spending** Expansion: 0.82 Linear: 0.93 Recession: 2.08	**Revenue** Expansion: -0.08 Linear: -0.17 Recession: 0.08	United States, Euro Area and Japan	TVAR
Baum and others (2012), 4 quarters	**Spending** Expansion: 0.82 Linear: 0.93 Recession: 2.08	**Revenue** Expansion: -0.08 Linear: -0.17 Recession: 0.08	G7 economies (excluding Italy)	TVAR
Blanchard y Perroti (2002)	Peak: DT: 1.29 ST: 0.90	Peak DT: -0.78, ST : -1.33	United States	SVAR

Contributions

- ✓ For the Colombian case, there are few studies on fiscal multipliers.
- ✓ There is not studies for Colombia that analyze Fiscal Multipliers as state-dependent .
- ✓ Model and evaluate empirically the nonlinear and asymmetric nature of FM .
- ✓ Implement a Bayesian approach for estimation.

Content

➢ **Data**:

- ❖ Period: 1995Q1 – 2015Q4
- ❖ Frequency: quarterly
- ❖ Time series:
  - Real Gross Domestic Product,
  - Tax revenue,
  - Public Expenditure,
  - *Exos*: Terms-of-Trade Index, Openness degree, the U.S Federal Funds rate, interbank interest rate (IBR) and the debt to GDP ratio

II. The Non-lineal Model:
VAR-LSTR (Logistic Smooth transition VAR)

$$Y_t = \begin{bmatrix} gdp_t \\ t_t \\ g_t \end{bmatrix} = A(L)Y_{t-1} + F(z_{t-d};\gamma;c)B(L)Y_{t-1} + D(L)\,Exos_t + u_t$$

$$F(z_{t-d};\gamma,c)=\mathrm{diag}(f_j)$$

$$f_j(\cdot) = [1 + exp\left\{-\frac{\gamma(z_t - c)}{\sigma_z}\right\}]^{-1}$$

II. VAR-LSTR … (cont.)

- $A(L)$ and $B(L)$ are *p*-order polynomial matrices; *L* being the lag operator.
- $F(z_{t-d};\gamma,c)$ is a diagonal matrix whose elements $f_j(\cdot)$ are transition functions, a cumulative logistical probability function for the *j*-th transition variable;
- z_t : a transition variable;
- γ: smoothing parameter (γ>0). If $\gamma \to 0 \Rightarrow$ SVAR becomes a VAR. When $\gamma \to \infty \Rightarrow$ an indicator function $I(z_t > c)$.
- c: Localization parameter; $\boldsymbol{\mu}$: vector of white noise processes.
- **All parameters** are estimated by **Bayesian methods** (similar to Gefang and Strachan, 2010; Gefang, 2012).

II. VAR-LSTR … (cont.)

Fiscal Multipliers (are obtained as the accumulated responses to a one shock to the respective variable:

$$FM_{\tau}^{n} = \sum_{j=0}^{\tau} \frac{\Delta Y(t+j)}{\Delta n(t)} \quad for\ n = T, E$$

- Structural shocks are identified by Cholesky ($\boldsymbol{u}_t = \boldsymbol{A}^{-1}\boldsymbol{\varepsilon}_t$, $\boldsymbol{A}$ is a triangular matrix superior and vector $\boldsymbol{\varepsilon}$ orthogonal shocks).

Transition variables tried

- DGDP : GDP growth (endogenos var.)
- HP : Hodrick-Prescott Filter
- CF : Christiano-Fitzgerald Filter
- FD : Ideal Band-Pass filter (Corbae-Ouliaris, 2006)
- DSGE : GDP-GAP González et al (2012)
- DGDP_MA: Moving Average(5) GDP growth
- HP_MA6 : Moving Avg.(6) of Hodrick-Prescott.

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III. results

Linear or nonlinear regression model?...

Model	Transition variable	p-lag	d-lag	Ln(BF)
VAR	Gy	2	NA	-45,8
LST-VAR	Gy	2	1	-540,2
LST-VAR	Gy	2	2	-543,9
VAR	Gy	3	NA	54,1
LST-VAR	Gy	3	1	-409,6
LST-VAR	Gy	3	2	-306,8

Source: Authors' calculations. "BF" means 'Bayes factor',
Ln: natural logarithm, and "NA" means 'Not Apply'.

Hint: Bayes factor...

Posterior odds of the null hypothesis, that is the degree to which we favor a null hypothesis (constant model) over an alternative (linearity or nonlinearity) after observing the data, given the prior probabilities on the null and alternative.

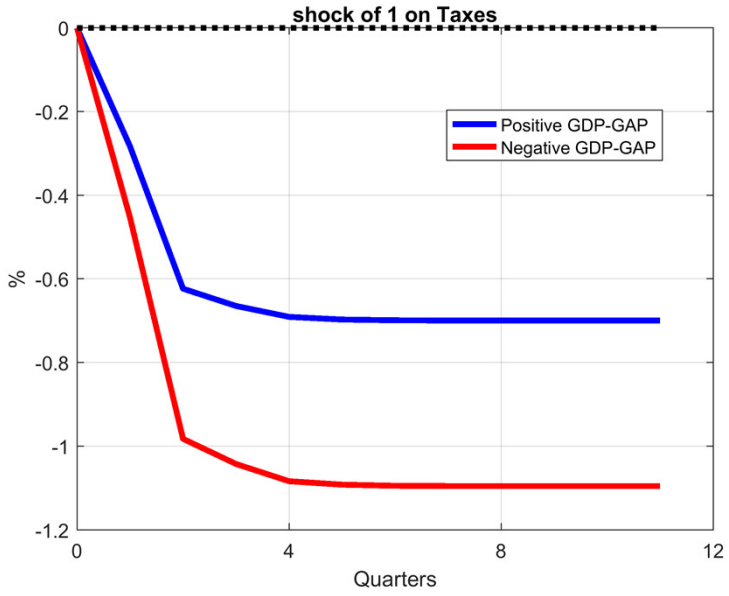
⇒The more negative “Ln(BF)”, the better specification is obtained.

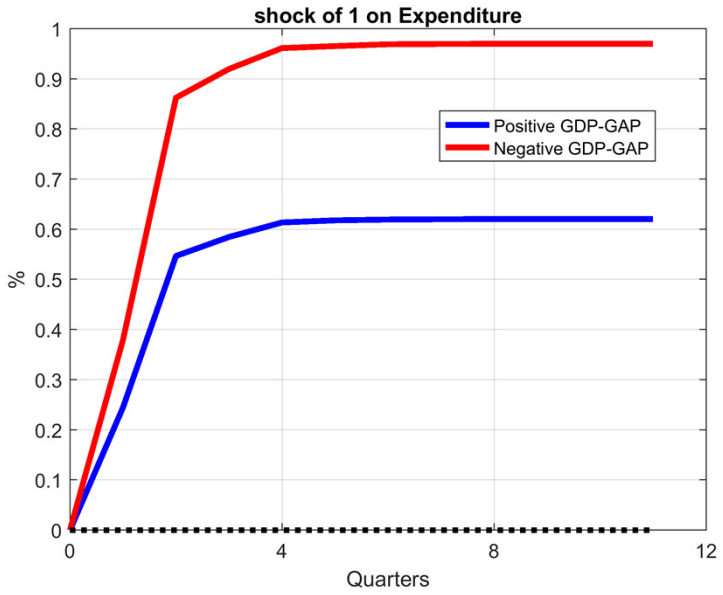
Parameter estimates of the LST-VAR...

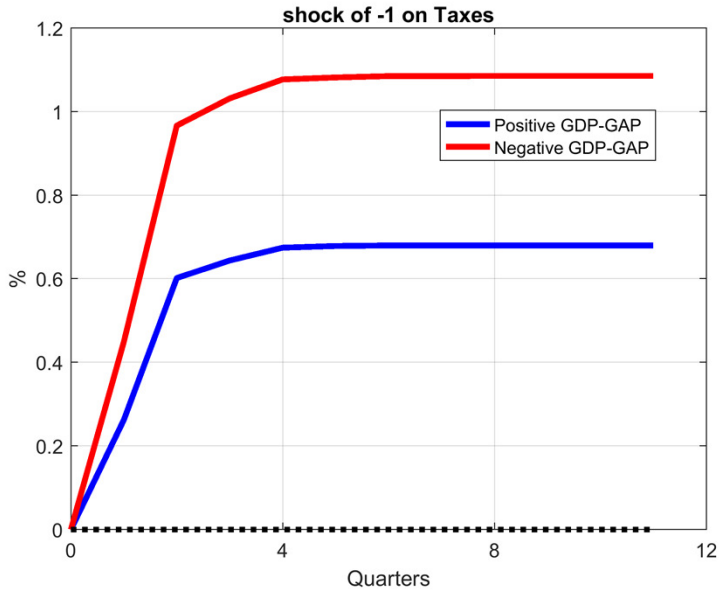
Transition variable	Estimated parameters		# obs. per regime		Threshold	p-lag	d-lag
	γ	c	Low	High			
HP-GAP	7,03	0,74	46	35	0,0	2	2

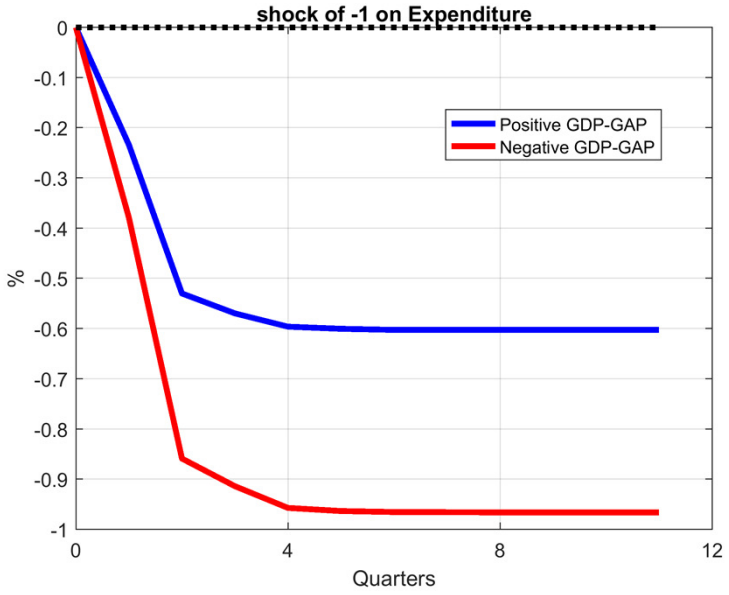
⇒ The estimated c is fairly located at the center of the distribution of the j − th transition variable.

FM for Public Expenditure and Tax revenues









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IV. Final Comments

- Another important finding is that tax multipliers appear to be slightly higher than expenditure, regardless of the state of the economy.
- Analyzing comparatively, it is worth noting an interesting fact is that the tax multiplier is above 1 in a state of the economy with a negative output gap.

Future work

- "Sign restricted Smooth Transition VAR models" by Bruns & Piffer (2016).
- Impose other structural restriction: Arias, Rubio-Ramírez & Waggoner (2012) "Inference Based on SVARs Identified with Sign and Zero Restrictions: Theory and Applications".
- Estimation by sub-periods.

Future work (cont.)

- Direct forecast as Auerbach & Gorodnichenko (2012), "…flexible alternative that does not impose dynamic restrictions implicitly embedded in VARs and that can conveniently accommodate nonlinearities in the response function."
- Given uncertainty on GAP variable: Bayesian Model Averaging.
- Disaggregated analysis.

Future work (cont.)

- To use alternative definition of Taxes and Expenditure as in Owyang, et al (2013, AER), Hall (2009) and Barro & Redlick (2011):

$$g_t=(G_t - G_{t-1})/Y_t$$

- Do estimation using variables in monetary terms (original units), as in Azmat & Qadeer (2016).

- Estimate a ST-VEC.

Thanks!

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Linear VAR *a lá* Blanchard & Perotti (2002) results