BANCO CENTRAL
DEL URUGUAY

Interdependency of fiscal and monetary policies: The case of Uruguay

Elizabeth Bucacos[1]

CEMLA's Joint Research Network 2020
Videoconferences
August, 5th-7th 2020

[1] **The opinions herein do not affect the institutional position of Banco Central del Uruguay.**

Roadmap

- Motivation
- Targets
- Approach
- Preliminary results
- To do list

Motivation

- The optimal monetay policy rule assumes that the fiscal policy is not relevant to the monetay policy.
- It is assumed implicitly that public debt is solvent, because it is possible to use the seigniorage as source of revenue.
- In fact, fiscal and monetary policies sholud be coordinated to keep macroeconomic stability.
- Sargent and Wallace (1981). Unpleasant monetarist arithmetic appears in a process of policy coordination in which fiscal policy dominates monetary policy.

  Active FP and passive MP.

Motivation

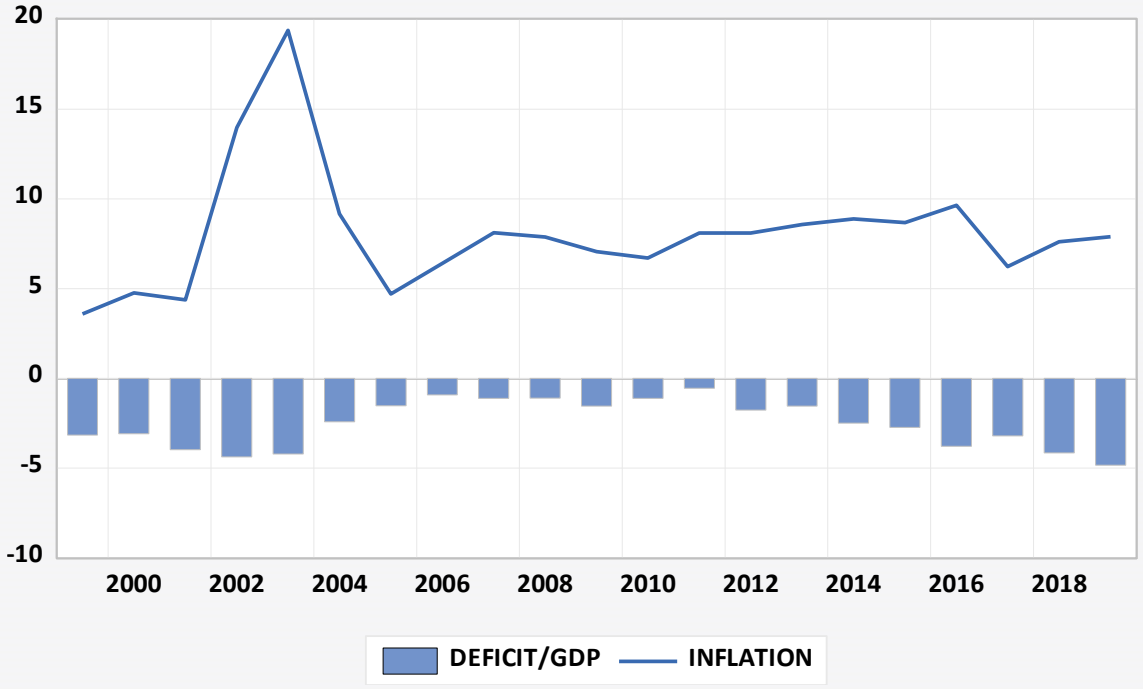
- Sargent (1986) makes a description of a Ricardian regime: monetary authority is the dominant player and fiscal authority is the follower. Passive FP and active MP.
- Leeper (1991). What distinguishes an active policy from a passive one is the fact that the active policy takes into account the expected future while the passive one relies on the behavior of current and past values of economic variables.
- The distinction between Ricardian and non-Ricardian regimes brings important implications to economic policies.

Motivation

- **Ricardian regime**: a good monetary policy is a necessary and sufficient condition to guarantee low inflation. An independent central bank with a strong institutional commitment towards price stability should compel the fiscal authority to adopt a responsible and appropiate fiscal policy.
- **non-Ricardian regime**: a good monetary policy is not a sufficient condition to ensure low inflation, unless additional measures are taken into consideration to restrict the freedom of the fiscal authority.

Motivation

- **Uruguay** has a history of persistent fiscal deficits and untamed inflation.



- Have we lived under a Ricardian or a non-Ricardian regime?

Targets

- Evaluate the **degree of fiscal dominance** in Uruguay in 1999-2019

- Analyze the **determining factors of the price level** (inflation) in Uruguay:
  - traditional theory (stock of money and the monetary policy),
  - FTPL (intertemporal government budget constraint and the fiscal policy), or
  - something in between.

Approach

- Fiscal dominance:
  - I. Find a measure of the independence degree of monetary policy decisions from fiscal policy De Rasende (2007)
  - II. Study the importance of financing fiscal deficits through seigniorage. Catao and Terrones (2005), Johansen (1988, 1991)
- Determinig factors of the price level – Catao and Terrones (2005), Hendry (2007), Johansen (1988, 1991)

Fiscal dominance I - Approach

Government's long-run fiscal policy rule:

- a given fraction (δ) of the outstanding debt is backed by the present discounted value of current and future primary surpluses.
- The remaining debt is backed by seigniorage revenue.

δ characterizes the degree of independence between FA/MA

δ = 1, fiscal authority backs fully all outstanding debt.
Zero fiscal dominance

δ = 0, all outstanding debt is backed by monetary authority.
Complete fiscal dominance

Fiscal dominance I - Approach

δ:

- **deep parameter** that shows the revealed preference of the government regarding the backing of its debt either by the fiscal or the monetary authority.
- It does not reflect a pubicly announced commitment.
- It does not reflect a commitment formally written in a country's budget, Constitution or central bank organic law.

Approach

The model

- **Consumers**: identical, infinitely-lived with perfect foresight (not crucial but analytically convenient)

$$\{c_t,n_t,m_t,b_t,k_t\} max \sum_{t=0}^{\infty} \beta^t u\left(c_t, {}^{m_t}/_{p_t}, 1-n_t\right)$$

where $\beta \in (0,1)$, u is increasing in all arguments, strictly concave, twice continually differentiable and satisfies INADA conditions.

Logarithmic and separable instantaneous utility function:

$$u\left(c_t, {}^{m_t}/_{p_t}, 1-n_t\right) = ln(c_t) + \gamma \ln\left({}^{m_t}/_{p_t}\right) + \theta \ln(1-n_t)$$

Approach

Budget constraint:

- $c_t + \frac{m_t}{p_t} + \frac{b_t}{p_t} + k_t = w_t n_t + r_t k_{t-1} + \frac{m_{t-1}}{\pi_t p_{t-1}} + i_{t-1} \frac{b_{t-1}}{\pi_t p_{t-1}} - \tau_t$

where

τ_t is a lump-sum tax, $\pi_t = {}^{p_t}/_{p_{t-1}}$ is the inflation rate, i_{t-1} is the gross nominal interest rate on Government debt set in period *t-1* and paid in period t, w_t is the wage rate, and r_t is the gross return to capital between periodos *t-1* and *t*. In equilibrium $r_t = {}^{i_{t-1}}/_{\pi_t}$

No-Ponzi condition.

Fiscal dominance I - Approach

FOC

$$1/c_t = \beta\left(i_t/\pi_{t+1}\right)\left(1/c_{t+1}\right) \quad \text{Euler eq. for consumption}$$

$$m_t/p_t = \gamma c_t i_t/(i_t - 1) \quad \text{Money demand}$$

Only these conditions are necessary to derive the model's implications for the aggregate price level.

Approach

- **Government**

In every period, it spends an exogenous amount of resources G_t, that may be financed by levying lump-sum taxes (τ_t), by issuing money (M_t) and by increasing public debt (B_t):

$$G_t + (i_{t-1} - 1)\frac{B_{t-1}}{p_t} = \tau_t + \frac{M_t - M_{t-1}}{p_t} + \frac{B_t - B_{t-1}}{p_t}$$

Forward iteration on its budget constraint and no-Ponzi condition imply an intertemporal budget contstraint:

$$i_{t-1}\frac{B_{t-1}}{p_t} = \sum_{j=0}^{\infty}\frac{\tau_{t+j}}{R_t^{(j)}} + \sum_{j=0}^{\infty}\frac{M_{t+j} - M_{t+j-1}}{p_{t+j}R_t^{(j)}} - \sum_{j=0}^{\infty}\frac{G_{t+j}}{R_t^{(j)}}$$

Approach

That is,

$$i_{t-1}\frac{B_{t-1}}{p_t} = \mathcal{T}_t + \mathcal{S}_t - \mathcal{G}_t$$

Definition: Given a sequence of prices $\{i_{t+j-1}, p_{t+j}\}_{j=0}^{\infty}$ and an initial sock of nominal debt B_{t-1}, a **δ-backing fiscal policy** is a sequence $\{G_{y+j}, \tau_{t+j}, B_{t+j}\}_{j=0}^{\infty}$ such that, for all t:

$$\mathcal{T}_t - \mathcal{G}_t = \delta i_{t-1}\frac{B_{t-1}}{p_t} \quad , \quad \delta \in [0,1]$$

A constant fraction (δ) of the outstanding Government debt + interests, is backed by the present discounted value of current and future primary surpluses.

Fiscal dominance I - Approach

Since the government's intertemporal budget contraint is always satisfied, it follows that:

$$\mathcal{S}_t = (1-\delta) i_{t-1} \frac{B_{t-1}}{p_t}$$

a fraction $(1-\delta)$ of the currently outstanding debt + interests is backed by the present discounted value of current and future seigniorage revenues.

The set of possible fiscal regimes is indexed by the fraction δ of the outstanding debt that is backed by the primary surplus.

Approach

- **Equilibrium**

It corresponds to a price system, allocations for the repesentative consumer and the representative firm, and a government policy such that:

(i) The representative consumer and the representative firm optimize given the government policy and the price system;

(ii) The government policy is budget-feasible given the price system and the choices of consumers:

(iii) Markets clear.

Approach

The *price level* is determined by the clearing of the money market:

$$M_t = m_t$$

Money supply: determined by the combination of the fiscal rule and the government's intertemporal budget constraint:

$$\frac{M_t}{p_t} = \frac{i_t}{i_{t-1} - 1}\left[(1-\delta) i_{t-1} \frac{B_t}{p_t} + \frac{M_{t-1}}{p_t} - \sum_{j=1}^{\infty} \frac{m_{t+j}}{p_{t+j} R_j^{(j)}} \frac{i_{t+j} - 1}{i_{t+j}}\right]$$

Money demand: given by the consumer's intertemporal condition.

Approach

Combining money demand and money market equilibrium condition:

$$\gamma c_t = (1-\delta) i_{t-1} \frac{B_{t-1}}{p_t} + \frac{M_{t-1}}{p_t} - \sum_{j=1}^{\infty} \left(\frac{m_{t+j}}{p_{t+j} R_j^{(j)}} \frac{i_{t+j} - 1}{i_{t+j}} \right)$$

The infinite sum can be expressed in terms of current comsumption and after some algebra:

$$p_t = \frac{(1-\beta)[M_t + (1-\delta)B_t]}{\gamma c_t}$$

Approach

- So,

$$p_t = \frac{(1-\beta)[M_t + (1-\delta)B_t]}{\gamma c_t}$$

The **price level** depends on:

(i) Consumption

(ii) The money stock

(iii) The proportion of the outstanding debt backed by money

Fiscal dominance I - Approach

Rewriting the price equation, we have

$$M_t = \frac{\gamma}{(1-\beta)} C_t - (1-\delta) B_t$$

which can be estimated as

$$M_t = \alpha_0 + \alpha_1 C_t + \alpha_2 B_t + \varepsilon_t$$

$$\alpha_1 = \frac{\gamma}{(1-\beta)}, \quad \alpha_2 = -(1-\delta), \qquad \rightarrow \quad \boldsymbol{\widehat{\delta} = 1 + \widehat{\alpha_2}}$$

M_t, C_t, B_t are endogenous to the model

are nonstationary variables but they can be Co-I.

Fiscal dominance I - Approach

Data: Monetary base (BM), M1 (M), Private Consumption (C), Total public sector net (and gross) debt (B), Gross Domestic Product (Y). All variables are expressed in billions of UY pesos. Sample: 1999Q4 – 2019Q4

Estimation method: DOLS (Stock and Watson 1993) Leads and lags are based on SIC criterion. HAC standard errors and covaviances

Cointegration tests: Hansen, Park, Engle-Granger, and Phillips –Ouliares reject the null hypothesis of no cointegrarion among M_t, C_t, B_t

Fiscal dominance I - Approach

	Dependent variable: BM	Dependent variable: M
Lead Lag	11 11	9 7
Consumption	7.1373 (1.1823)	3.4660 (1.2410)
Debt	-0.0492 (0.0120)	-0.1920 (0.0108)
Trend	-0.0091 (0.0015)	-0.0022 (0.0019)
Constant	-4.1574 (0.7285)	-1.6769 (0.7452)
$\hat{\delta}$	**0.9508**	**0.8080**

Fiscal dominance I - Preliminary results

- We found a fiscal/monetary regime with low degree of fiscal dominance.

- This value is robust to relevant shocks, such as the one occurred in 2002-03.

Fiscal dominance II - Approach

Catao and Terrones (2005)

- Macroeconomic theory postulates that persistent fiscal deficits are inflationary.
- But it has been hard to find a strong and statistically significant connection between the fiscal deficit and inflation.
- CT develop a simple intertemporal optimization model

to show that equilibrium inflation is directly related to the fiscal deficit scaled by narrow money, where the latter stands for the size of the inflation tax base.

Fiscal dominance II - Approach

Catao and Terrones (2005)

- This distinction between the proposed specification and the standard practice of scaling deficit by GDP is not only theoretically appealing but also empirically relevant, since it introduces a key non-linearity in the model—namely, it allows a given change in the deficit-to-GDP ratio to have a stronger impact in higher-inflation economies, where inflation tax bases are typically narrower.

Fiscal dominance II - Approach

Stationary equilibrium: $$\frac{\pi}{1+\pi} = \frac{p[g - \tau + b^g(R-1)]}{M}$$

- The **rate of inflation** is proportional to the ratio of gross-of-interest government deficit to the average stock of transaction or "narrow"money during the period.
- With the demand for transaction money being negatively related to inflation, the size of the inflation tax base will be lower (higher) as inflation is higher (lower).

Fiscal dominance II - Approach

- **Data**. M1' (M), Consumer Price Index (P), GDP (Y), nominal exchange rate (UY Pesos/USA dollar, E), foreign Price Index (P*), nominal wage index (W), potential output (Y_{pot}), unemployment rate (μ), openness ratio (opn), fiscal deficit ratio (d), international prices of food (P_f), beef (P_m), soybean (P_s) and oil (P_{oil}). All variables are indexes (2004=100), except rates and y ratios. Lower case names indicate logarithms. Sample: 2004Q4-2019Q4, 61 observations after adjustments.
- **Estimation methods**: VECM
- **Cointegration test**: Johansen´s test indicates 5 cointegrating vectors

Fiscal dominance II

- Cointegrating vectors:

$$\frac{m_t}{p_t} = -13.7875 + 3.2957\, y_t - 0.03206\, i_t + 0.0091\, d_t - 0.0109\, T_t + \varepsilon_{mt} \quad (1)$$

$$\frac{e_t p_t^*}{p_t} = 6.1340 - 0.0193\, d_t - 0.0132\, T_t + \varepsilon_{et} \quad (2)$$

$$\frac{w_t}{p_t} = -1.9066 + 0.2196 y_t - 0.0020 op_t + 0.0076\, T_t - 0.0056\, DT_{2013} + \varepsilon_{wt} \quad (3)$$

$$y_t = 2.7596 + 0.4305\, p_t - 0.0310\, \mu_t + 2.7597\, T_t + \varepsilon_{y1,,t} \quad (4)$$

$$y_t = 1.8511 + 0.7264\, y_{pot,t} - 0.1502\, e_t - 0.0012\, op_t + \varepsilon_{y2,t} \quad (5)$$

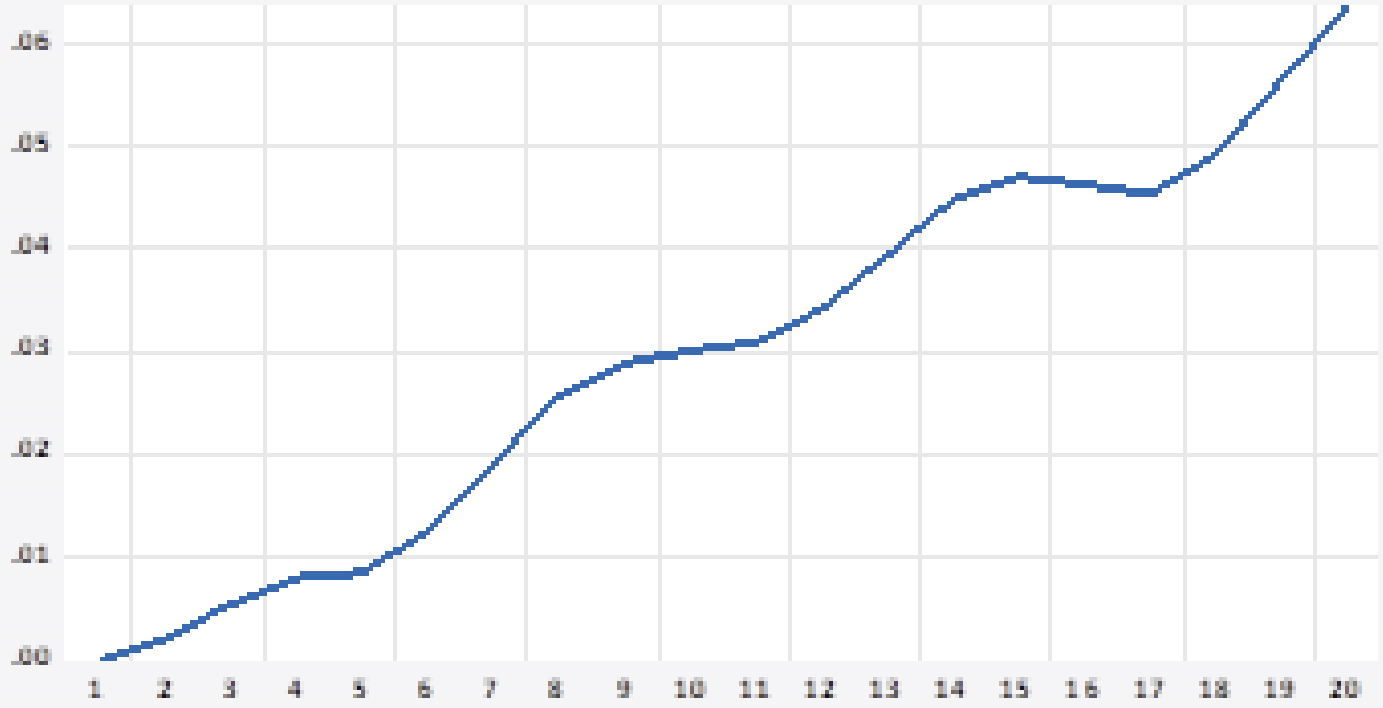
Fiscal dominance II

Weak exogeneity

VC	p	m	i	e	p*	w	y	y_{pot}	d	op	μ
1	x	x	√	√	√	√	√	√	√	√	√
2	x	√	√	√	√	√	√	√	x	√	√
3	√	√	√	√	√	x	√	√	√	√	√
4	x	√	√	√	√	√	√	√	√	√	√
5	√	√	√	√	√	√	x	√	√	√	√

Fiscal dominance II – Preliminary results

Accumulated response of consumer prices to fiscal deficit
Generalized one s.d. innovations



Fiscal dominance II – preliminary results

VARIANCE DECOMPOSITION OF CONSUMER PRICES (In %)								
Period	S.E.	Inertia	Monetary policy	Exchange Rate	Foreign prices	Wages	Fiscal deficit	Other
1	0.0000	74	0	0	26	0	0	0
2	0.0067	58	2	1	17	7	5	11
3	0.0104	29	12	1	15	13	7	23
4	0.0152	19	13	3	25	13	6	22
5	0.0203	16	9	2	36	10	3	25
6	0.0255	14	7	1	33	9	4	32
7	0.0300	11	6	1	29	8	6	40
8	0.0337	9	6	2	27	8	7	42
9	0.0366	9	6	2	27	8	6	42
10	0.0395	9	5	2	28	8	5	42

Fiscal dominance I and II

- It seems as if the fiscal/monetary regime in Uruguay has a **relatively low degree** of direct fiscal dominance:

1. The revealed preference parameter is estimated to be in the range $\mathbf{0.8077} \leq \boldsymbol{\delta} \leq \mathbf{0.8083}$ (for M1').
2. Fiscal deficits explain about 5% of the consumer prices variance

- The inflation process seems not to be an exclusively monetary phenomenon.

To do list

- Incorporate your comments and suggestions
- Finish writing a preliminary paper

Thank you for your attention!