Interdependency of fiscal and monetary policies: The case of Uruguay

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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 monetary policy rule assumes that the fiscal policy is not relevant to the monetary 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 should 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 appropriate 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:
  o traditional theory (stock of money and the monetary policy),
  o FTPL (intertemporal government budget constraint and the fiscal policy), or
  o 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)

Fiscal dominance I - Approach

Government’s long-run fiscal policy rule:
• a given fraction ($\delta$) 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.

$\delta$ characterizes the degree of independence between FA/MA
$\delta = 1$, fiscal authority backs fully all outstanding debt.
Zero fiscal dominance
$\delta = 0$, all outstanding debt is backed by monetary authority.
Complete fiscal dominance
Fiscal dominance I - Approach

\( \delta: \)

- **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 publicly 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)

\[
\max_{\{c_t, n_t, m_t, b_t, k_t\}} \sum_{t=0}^{\infty} \beta^t u(c_t, m_t/p_t, 1 - n_t)
\]

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:

\[
u(c_t, m_t/p_t, 1 - n_t) = \ln(c_t) + \gamma \ln(m_t/p_t) + \theta \ln(1 - n_t)\]
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

\( \tau_t \) is a lump-sum tax, \( \pi_t = \frac{p_t}{p_{t-1}} \) 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 \( r_t = \frac{i_{t-1}}{\pi_t} \)

No-Ponzi condition.
Fiscal dominance I - Approach

FOC

\[ \frac{1}{c_t} = \beta\left(\frac{i_t}{\pi_{t+1}}\right)\left(\frac{1}{c_{t+1}}\right) \]

Euler eq. for consumption

\[ \frac{m_t}{p_t} = \gamma \frac{c_t i_t}{(i_{t-1})} \]

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 ($\tau_t$), 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 constraint:

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

That is,

\[ i_{t-1} \frac{B_{t-1}}{p_t} = \mathcal{T}_t + S_t - G_t \]

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

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

A constant fraction (\( \delta \)) 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 constraint is always satisfied, it follows that:

$$S_t = (1 - \delta)i_{t-1} \frac{B_{t-1}}{p_t}$$

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 $\delta$ of the outstanding debt that is backed by the primary surplus.
Approach

• Equilibrium

It corresponds to a price system, allocations for the representative 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:

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

The infinite sum can be expressed in terms of current consumption 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
Rewriting the price equation, we have

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

which can be estimated as

\[ M_t = \alpha_0 + \alpha_1 C_t + \alpha_2 B_t + \epsilon_t \]

\[ \alpha_1 = \frac{\gamma}{(1-\beta)}, \quad \alpha_2 = -(1 - \delta), \quad \rightarrow \hat{\delta} = 1 + \hat{\alpha}_2 \]

\( M_t, C_t, B_t \) 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 covariances

**Cointegration tests**: Hansen, Park, Engle-Granger, and Phillips –Ouliarres reject the null hypothesis of no cointegration among $M_t$, $C_t$, $B_t$
## Fiscal dominance I - Approach

<table>
<thead>
<tr>
<th></th>
<th>Dependent variable: BM</th>
<th>Dependent variable: M</th>
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<tr>
<td><strong>Lag</strong></td>
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<td>7</td>
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<tr>
<td><strong>Consumption</strong></td>
<td>7.1373 (1.1823)</td>
<td>3.4660 (1.2410)</td>
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<td><strong>Debt</strong></td>
<td>-0.0492 (0.0120)</td>
<td>-0.1920 (0.0108)</td>
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<td><strong>Trend</strong></td>
<td>-0.0091 (0.0015)</td>
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<td><strong>Constant</strong></td>
<td>-4.1574 (0.7285)</td>
<td>-1.6769 (0.7452)</td>
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<tr>
<td><strong>( \hat{\delta} )</strong></td>
<td>0.9508</td>
<td>0.8080</td>
</tr>
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</table>
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 ($\mu$), 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:**

\[
\frac{m_t}{p_t} = -13.7875 + 3.2957 y_t - 0.03206 i_t + 0.0091 d_t - 0.0109 T_t + \varepsilon_{mt} \tag{1}
\]

\[
\frac{e_t p_t^*}{p_t} = 6.1340 - 0.0193 d_t - 0.0132 T_t + \varepsilon_{et} \tag{2}
\]

\[
\frac{w_t}{p_t} = -1.9066 + 0.2196 y_t - 0.0020 o p_t + 0.0076 T_t - 0.0056 DT_{2013} + \varepsilon_{wt} \tag{3}
\]

\[
y_t = 2.7596 + 0.4305 p_t - 0.0310 \mu_t + 2.7597 T_t + \varepsilon_{y1,t} \tag{4}
\]

\[
y_t = 1.8511 + 0.7264 y_{pot,t} - 0.1502 e_t - 0.0012 o p_t + \varepsilon_{y2,t} \tag{5}
\]
## Fiscal dominance II

### Weak exogeneity

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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 %)

<table>
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<tr>
<th>Period</th>
<th>S.E.</th>
<th>Inertia</th>
<th>Monetary policy</th>
<th>Exchange Rate</th>
<th>Foreign prices</th>
<th>Wages</th>
<th>Fiscal deficit</th>
<th>Other</th>
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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 $0.8077 \leq \delta \leq 0.8083$ (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!