THE INTERDEPENDENCE OF FISCAL AND MONETARY POLICY

THE INTERDEPENDENCE OF FISCAL AND MONETARY POLICIES IN URUGUAY

By Elizabeth Bucacos

Editors:
Jorge Ponce and Santiago García-Verdú

2020 Joint Research Program

XXV Meeting of the Central Bank Researchers Network

The Interdependence of Fiscal and Monetary Policies in Uruguay*

Elizabeth Bucacos†

Banco Central del Uruguay

February, 2021

Abstract

The global COVID-19 pandemic has called for heightened levels of policy intervention stressing government accounts and amplifying their impact on the macroeconomy through an already nonexistent fiscal space. Policymakers' choices during this disruption may shape the economy for decades to come. The main objective of this investigation is to evaluate the degree of fiscal dominance in Uruguay in 1999-2019 in order to improve the understanding of economic policy not only for theoretical reasons but for applied needs related to good practices and accountability. Two strategies are followed: one, to quantify the fraction of fiscal expenditures that is financed by monetary liabilities and, the other one, to analyze the effects of fiscal deficit on the price level and inflation because inflationary financing may prevent the central bank from reaching its inflation target. Both situations may subordinate the monetary policy to the fiscal policy signaling fiscal dominance. In addition, through the analysis performed to assess the degree of fiscal dominance, it was possible to detect the main determining factors of the Uruguayan price level (inflation) formation during the last two decades. So far, preliminary results suggest that inflation is not exclusively a monetary phenomenon and point to some inflationary financing with a mild degree of fiscal dominance.

JEL Codes: E52, E63.

Keywords: monetary policy, joint analysis of fiscal and monetary policy, Uruguay.

*This research was developed within the framework of CEMLA's Joint Research Program 2020. The opinions expressed in this publication are those of the author and do not reflect the views of CEMLA or the Central Bank of Uruguay. She is thankful for comments and suggestions by Jorge Ponce, Carlos Urrutia, two anonymous peer referees, participants of CEMLA Joint Research 2020 Virtual Intermediate Meetings on 17th-19th June and on 5th-7th August, 2020, and helpful advice by Marcelo Alvez for the latex version.

†E-mail: ebucacos@bcu.gub.uy.

1 Introduction

The interrelationship between monetary and fiscal policies is a crucial topic in macroeconomic design. In fact, fiscal and monetary policies should be coordinated to keep macroeconomic stability. Sargent et al. (1981) point out that some unpleasant monetarist arithmetic appears in a process of policy coordination in which fiscal policy dominates monetary policy. The solution given by standard monetarist doctrine is to ensure that the central bank has an unwavering commitment to price stability. But in some situations, however, the goal of price stability may remain elusive when the fiscal authority cannot be compelled to follow an appropriate fiscal policy no matter how tough and independent the central bank is. As a result, price stability requires an appropriate monetary policy and an appropriate fiscal policy as well. Woodford (1994) named it the *fiscal theory of price level* (FTPL) owing to the greater attention given to fiscal policy in price-level determination.

The conventional view[1] advised that central bankers should keep some distance from fiscal authorities in order to avoid pressures to finance fiscal imbalances that could hurt central bank's price goals. On the other hand, the FTPL theory implies that central bankers have to get closer to fiscal authorities and induce them to behave appropriately. In essence, the conventional doctrine and the FTPL differ in their views of the government's intertemporal budget constraint. That equation states that the value of government debt is equal to the present discounted value of future government tax revenues net of expenditures (that is, surpluses), where both debt and surpluses are denominated in units of goods:

$$\frac{B}{P} = \text{present value of future surpluses} \tag{1}$$

where B is the outstanding nominal debt of the government and P is the price level. The conventional view states that this equation is a constraint on the government's tax and expenditure policy: this implies that fiscal policy must be designed so that the right-hand side equals the left one, whatever the value of P. Accordingly, if equation (1) is disturbed the government must modify its taxes or its expenditures or both to restore equality. On the other hand, FTPL advocates say that there is no inherent requirement for fiscal authorities to treat equation (1) as a constraint on policy. In their view, the intertemporal budget equation is an *equilibrium condition*: when something disturbs the equation, the market-clearing mechanism moves the price level P to restore equality. The assumption that government policy is not calibrated to satisfy the intertemporal budget equation for all values of P was called the *non-Ricardian assumption* by Woodford (1998).

Although the non-Ricardian assumption is not a good characterization of policies in all times and places, it may provide a useful characterization of actual policies in some

[1] See Farmer & Zabczyk (2019).

contexts. For instance, optimal policies might themselves be non-Ricardian because some price instability may be desirable when unavoidable shocks to the government budget constraint occur (Sims 1994, Woodford 1998). The idea is that it is efficient to absorb unanticipated shocks to the price level with capital levies on bondholders of government debt rather than changing distortionary taxes. In practice, non-Ricardian policies are bad. If tax cuts or increases in government spending were not to be paid for with higher taxes later fiscal authorities would be prone to follow policies that imply too much spending and too much debt. In that way the FTPL implies that such policies could occur in the absence of specific measures to rule them out (Christiano & Fitzgerald 2000). Debt limitations imposed by the IMF and by the Maastrich Treaty could be seen as examples of those measures.

De Resende (2007) based on the theoretical work in Aiyagari & Gertler (1985) aims to evaluate the degree to which fiscal dominance could be present. A key assumption is that the government commits to collect the necessary net fiscal resources to back a fraction (δ) of the outstanding nominal debt. The fraction $(1-\delta)$ is obtained from seigniorage. If δ is close to one, then there is evidence that monetary policy is being implemented independently of fiscal policy. A statistically significant value of δ lower than one, could be evidence of accommodative monetary policy to some fiscal pressure. According to De Resende (2007), there are differences in the degree of fiscal dominance between developed and developing economies and also estimates correlate positively with institutional measures of de facto central bank independence. Catao & Terrones (2005) analyze the extent to which the fiscal deficits affect inflation. The authors propose an autoregressive distributed lag (ARDL) econometric model to study the long-run relationship between fiscal deficits and inflation dynamics.

Marandino & Oddone (2018) analyzed the Uruguayan monetary and fiscal policies interaction in 1960-2017 using *the budget constraint approach*[2]. It was originally developed by Sargent et al. (1981) to evaluate the impact of the set of monetary and fiscal policies implemented in the United States in the early 1980s. This framework consists of two main ideas: a budget identity for the consolidated government and a demand for real money Kehoe et al. (n.d.). The budget identity classifies all sources of government financing into three groups: tax revenues, interest-bearing debt, and non-interest bearing debt or money. Basically, it imposes a constraint between four different dimensions of macroeconomic policy: total government expenses, total revenues, increases in government debt, and increases in the money supply. The constraint implies that the four different policy decisions cannot be made independently: once three of them are decided, the fourth one has to adjust to satisfy that constraint. So, a deficit implies an increase in government debt, an increase in the money supply, or a combination of both. The demand for real money establishes a systematic relationship between the general price level, short-term

[2]For a detailed description, see the Appendix.

nominal interest rates, total real income, and some measure of money. It implies that systematic increases in the money supply generate inflation. The combination of these two main ideas does not imply that sustained deficits cause inflation, since they can be financed by increases in government debt. Nevertheless, debt implies a promise of future government surpluses to be used to pay for that debt. To the extent that these promises lack credibility, the government may face a limit on its ability to borrow. If this is the case, the combination of the two ideas implies a direct connection between fiscal deficits and inflation. Thus, the size of interest-bearing debt relative to total production plays a key role.

Table 1: Consolidated budget constraint of the Uruguayan Public Sector: 1960-2017

Sources (in %)	**1960-1973**	**1974-1990**	**1991-2017**
Local currency public debt (var.)	-1.1	0.4	0.2
Foreign currency public debt (var.)	0.9	4.4	-0.8
Inflation-indexed public debt (var.)	-	-	0.8
Wage-indexed public debt (var.)	0.1	0.1	-0.1
Monetary base (var.)	-0.2	-0.4	0
Inflation tax	4.7	3.6	0.8
Total	**4.4**	**8**	**1**
Obligations (in %)			
Public sector primary deficit	5.9	1.8	-1.1
Local currency return	-	-	0
Foreign currency return	0.1	2.8	0.9
Inflation-indexed return	-	-	-0.1
Transfers	-1.6	3.5	1.3
Total	**4.4**	**8**	**1**

Notes: Transfers are estimated as a residual. The "consolidated budget constraint" includes the general government, state-owned enterprises, and the financial public sector.
Source: Marandino & Oddone (2018).

.

Marandino & Oddone (2018) main results, presented in Table (1), can be summarized as: *(a)* in 1960-2017, the financing of Uruguay´s public sector was mostly inflationary. On average two thirds of total sources came from inflation tax[3] and one-third came from public debt; *(b)* between the 1960s and the late 1980s, chronic inflation was associated with large fiscal deficits; *(c)* since the 1970s, but especially after 1991, owing to significant macroeconomic measures[4] the inflationary financing of fiscal deficit decreased; *(d)* Uruguay had to endure two major crises: one in 1982 and another in 2002. The former was very costly in fiscal terms and brought back the monetization of deficits, while

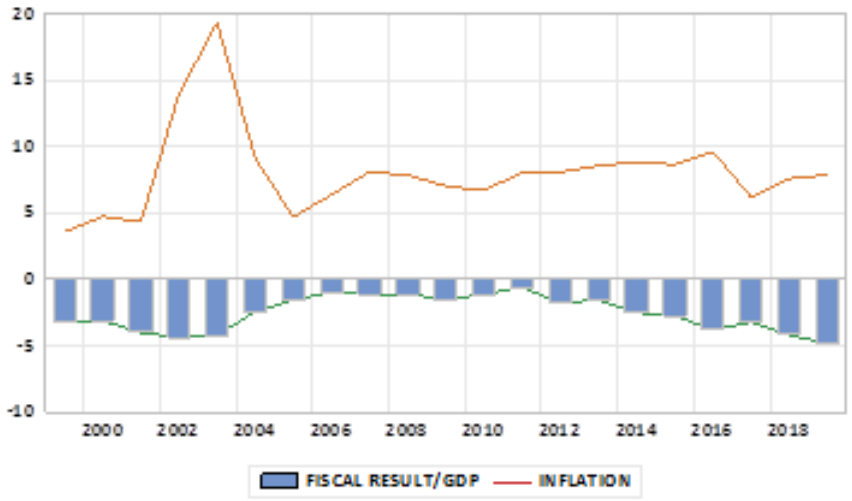
[3]That is: (4.7+3.6+0.8)/(4.4+8.0+1.0).

[4]Mainly, the opening of the economy, financial liberalization, greater access to external financing, stabilization plans, and the more restrictive institutional framework of the central bank.

the latter had significantly lower effects on the deficit and inflation. This suggests that governments have slowly understood the importance of fiscal constraints to guarantee nominal stability.

Uruguay has a history of persistent fiscal deficits and untamed inflation. During its 190-year life as an independent country, and especially after 1991, it has undertaken relevant measures to deal with those problems aiming at a more independent and transparent central bank. Figure (1) depicts the consolidated fiscal result over GDP and annual inflation rate — measured as 12-month Consumer Price Index (CPI) changes — for 1999-2019[5]. Clearly, there are imbalances in the fiscal policy and in the monetary policy as well. See Figure (1). Licandro (2000) and Licandro & Vicente (2006) analyze the role of fiscal incentives in time inconsistency policies in Uruguay.

Figure 1: Uruguay: fiscal result and annual inflation rate, 1999-2019.
In percentage rates



Notes: Consolidated fiscal result over GDP and annual inflation rate measured as 12-month Consumer Price Index (CPI) changes. Source: author´s calculations based on BCU and INE data.

The main objective of this investigation is to evaluate the degree of fiscal dominance in Uruguay in 1999-2019. The estimation strategy involves two approaches: one of them following De Resende (2007) assesses the relevance that seigniorage has to back the outstanding nominal debt, and the other one analyses the fiscal deficit effects on inflation, modifying Catao & Terrones (2005) model to a time series approach in a multicointegration framework that takes into account more than one long-run relation and diverse sources of consumer price changes. The latter procedure points to the main determining factors of the Uruguayan price level (inflation) formation during the last two decades and helps to decide whether the price level can be better explained by the traditional theory (based on the stock of money and the monetary policy), by the fiscal theory FTPL

[5]The econometric analyses that follows expand from 1999 to 2019 because of data availability

(based on the intertemporal government budget constraint and the fiscal policy), by a combination of both or of many other sources.

The rest of this document is organized as follows. Uruguayan institutional framework is presented in Section 2. Next, data and methodological approaches are explained. Then, results are discussed. Finally, some conclusions are drawn.

2 Institutional Arrangement for Fiscal and Monetary Policies in Uruguay

This section succinctly presents the institutional framework where fiscal and monetary policies interact and describes that interaction with a focus on the 1990-2019 timespan.

2.1 Institutional Setup[6]

Traditionally, August 25th 1825, is considered the date of birth of the Oriental Republic of the Uruguay[7]. It can be said that there is a *foundation process* of the Central Bank of Uruguay that spanned more than a century. See Tables (2) and (3).

2.2 Monetary and Fiscal Policies Interaction, 1990-2019

In 1990 the Uruguayan government put forward a price stabilization plan based on a deep fiscal adjustment[8] and a crawling band[9]. The nominal exchange rate anchor was kept for the whole decade and the primary fiscal deficit remained balanced until 1999. During this period, the real currency appreciation incentivized borrowing in foreign currency and led to a strong public debt profile in foreign currency (91.3 percent of total public debt in 1998). The key role of international reserves became apparent because they had to guarantee the exchange rate commitment, public debt service and bank deposits[10] Unfortunately, they proved insufficient when a series of negative external shocks between 1999 and 2001 attacked the already fragile Uruguayan economy. As many ana-

[6]Most of the information presented here comes from BCU´s website.

[7]Some historians discuss over the date of "beginning" of Uruguay as an independent country: whether it corresponds to its Independency Declaration (August 25, 1825), to its Oath of the Constitution (July 18, 1830) or the Preliminary Peace Convention signature (August 27, 1828).

[8]Fiscal deficit was around 6 percent of GDP in 1990-1991.

[9]According to Bubula & Otker-Robe (2002) classification, in a crawling band regime the currency is maintained within fluctuation margins of at least ±1 percent around a formal or de facto central rate, which is adjusted periodically in small amounts at a fixed rate or in response to selective quantitative indicators. The commitment to maintain the exchange rate within the band imposes constraints on the monetary policy, with the degree of policy independence a function of the bandwith.

[10]There was an implicit deposit insurance scheme. Historically, the monetary authority had always bailed out banks in financial distress and had also absorbed their workers.

Table 2: The Central Bank of Uruguay foundation process

August 4, 1896	**Charter of the Bank of the Oriental Republic of Uruguay** (BROU) was approved.
August 24, 1896	BROU formally constituted and included in its activities functions common to central banks.
August 14,1935	**The Issuing Department** was separated from other banking services and it was granted the authority to issue money and to perform other functions inherent to central banks (e.g. the analysis of all issues related to monetary policy, formulating objectives and management, oversight and audit of the provisions referring to the regulatory regime of private, national and foreign banks).
January 2, 1939	A **new charter** was approved, categorizing it as an autonomous entity and establishing two separate departments, the Bank and the previously established Issuance Department. Additional functions were assigned to the Issuance Department in new provisions, granting it the responsibility of making coins, following instructions by the Legislative Branch.
Between 1936-1966	Growing economic deterioration – marked by chronic inflation, scarce international reserves, the aftermath of the 1965 banking crisis, and the inflation-devaluation spiral (Oddone and Marandino, 2019) – different sectors of public opinion discussed the possibility of creating a central bank.
November, 1966	A **plebiscite** was held to vote on a constitutional reform. The result of the vote was the approval of a new Constitution (known as Constitution of 1966), which established the **Central Bank as an autonomous entity with technical, administrative and financial autonomy** (Article 196), and entrusted the legal system to approve the corresponding Charter. The same constitutional text established in its temporary and special provisions the opening date for the institution as March 1, 1967 (Appendix H), the method for integration (Appendix F), and the Bank's mission and responsibilities. (They were the same as the ones that the BCU Issuance Department had at the time). During the transition time (1967–1971), the state-owned commercial bank Banco República (BROU) and the Central Bank of Uruguay shared the functions of a monetary authority (Marandino & Oddone 2018).
September 17, 1982	A set of norms were formalized regulating financial intermediation activities.

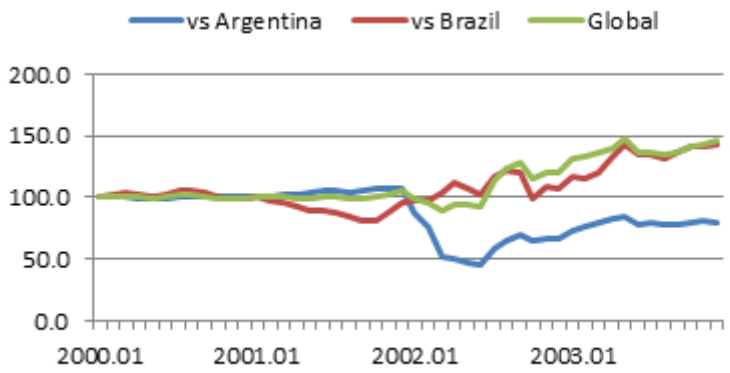
Table 3: The Central Bank of Uruguay foundation process (Cont)

March 30, 1995 (modified later in October 24, 2008)	The **Central Bank of Uruguay's Charter was approved**. Main changes: a) identification of its main objectives (e.g. to obtain price stability that contributes to economic growth and employment, to regulate and supervise payment systems and the financial system in order to promote a sound, solvent, efficient system and its development, b) increase in the number of directors from three to five, c) modification of the time directors served making the term coincide with the change of government (they are appointed by the President of the Republic with consent of Minister's Council and previous approval of the Senate), d) creation of a Superintendency of Financial Services, reporting to the Board of Directors, independent with technical and operational autonomy, e) inclusion of the supervision of other entities previously not included, f) creation of a Corporation for the Protection of Bank Savings (Corporación de Protección del Ahorro Bancario - COPAB in Spanish) a non-government public person separate from the Bank, to assist entities in crisis, to conduct administrative liquidations, manage the Funds for Guarantee of Bank Deposits, and pay deposits insurance.
1995	Parliament approved a new central bank act that **strengthened the commitment to avoid inflationary financing**. It set a limit on the assistance the central bank could offer to the rest of the public sector: (1) it limited the stock of public debt the central bank could hold to 10 percent of the primary budget of the previous year; (2) it allowed the central bank to grant loans ("temporary transfers") for an amount not greater than 10 percent of the primary budget of the previous year. The former remains in force, and the latter was derogated by law in 1997 (Marandino & Oddone 2018).
July 20, 2010	Introduced **new important modifications to the Charter**, such as changing the number of Directors to three members, the creation of a Macroeconomic Coordinating Committee (with participation of the Minister of Economy and Finances), and a Committee of Monetary Policy within the scope of the Bank with specific functions of monetary issues.

Notes: Banco Central del Uruguay's web site and Marandino & Oddone (2018) were used for this classification.

lysts have pointed out[11], it is fair to say that the 2002 banking crisis in Uruguay might not have occurred had Argentina not collapsed first. But this exogenous contagion to the Uruguayan financial sector was magnified by inherent weaknesses of the Uruguayan economy and its banking sector. In effect, by the end of 2001, the Uruguayan economy was characterized by weaknesses of the public banks, high level of foreign indebtedness — both private and public and economic activity stagnation derived from an appreciated Uruguayan peso's real exchange rate against its major trade partners. See Figure (2).

Figure 2: Uruguayan real exchange rate



Notes: Source: author's calculation based on BCU data. Real exchange rate indexes (2000.01=100) show bilateral relations Uruguay-Argentina and Uruguay-Brazil and a multilateral relation Uruguay with its main trade partners.

In the Summer of 2001-2002, the end of the convertibility plan in Argentina led to a run on non-resident (first) foreign currency denominated bank deposits that escalated despite of the diligent provision of liquidity support to the needed banks done by Uruguayan authorities. As the Argentinian crisis deepened a second wave of withdrawals made the level of international reserves in Uruguay clearly insufficient to both service the external debt and continue backing the large proportion of foreign currency denominated deposits still present within the system (US 8.7 billion as of July 2002). The Uruguayan authorities had to let the peso freely float — which immediately depreciated by 27 percent — and declared a five-day bank holiday on July 30, 2002. While this devaluation favoured export growth and helped to the recovery of the real economy later that year, it turned the public debt unsustainable (Rial & Vicente 2003). Just after the lifting of the bank holiday on August 5, 2002, a new legislative framework (Ley 17.523) was designed; it included a series of measures aimed at finally put an end to the crisis. In particular, in May 2003 Uruguay successfully re-scheduled a large proportion of its foreign currency denominated

[11] De la Plaza & Sirtaine (2005), Paolillo (2004), among others. See De la Plaza & Sirtaine (2005) for a more detailed description of the Uruguayan banking crisis.

debt[12]. The return of the deposits to the system validated this debt exchange, with total level of deposits of the system growing by 3 percent during May alone.

The economic policy implemented since 2003 was aimed at reducing those macroeconomic fragilities that amplified the external shocks. The adopted scheme was based on inflation targets (since 2005), the consolidation of a primary fiscal surplus, and a stronger management of the public sector's assets and liabilities, especially public debt (Marandino & Oddone 2018). These structural reforms enabled Uruguay to leave the crisis behind and to begin, by the third quarter of 2003, a steady growing path[13]. Unfortunately, by 2013 economic slowdown was apparent. But fiscal policy was not tight during the expansive phase of the cycle and, in a full employment context, wage policy added nominal rigidity. As a result, by 2014 some signs of deterioration appeared. In 2015-19 primary deficit averaged 2.89 percent of GDP and inflation was above the target range between September 2011 and December 2019.

The previous analysis on the last decades shows the importance of coordination between monetary and fiscal policies to keep macroeconomic stability.

3 Fiscal Dominance

In this section, I focus on the search for a measure of actual fiscal dominance in Uruguay in the last 21 years regardless of the formal structure that regulates monetary and fiscal relations. I follow two different approaches. On the one hand, I try to quantify the fraction of fiscal expenditures that is financed by monetary liabilities. On the other one, I analyze the effects of fiscal deficit on the price level and inflation because inflationary financing may prevent the central bank from reaching its inflation target. Both situations may subordinate the monetary policy to the fiscal policy signaling fiscal dominance.

3.1 Public Debt and Money

In this section, I follow De Resende (2007). For details see Appendix (B).

3.1.1 Methodological Approach

The key equation in his model is the government's long-run fiscal policy rule. It states that a given fraction (δ) of the outstanding debt is backed by the present discounted value

[12]The participation of the debt exchange was unusually high: US 5 billion worth of principal amount was rendered for exchange, approximately 93 percent of eligible bonds. Domestic participation was extremely high, with 100 percent participation by domestic financial institutions and 98 percent by domestic retail investors.

[13]This longest growth period since the 1940s was fueled by the super cycle of commodity prices, strong external demand, and extraordinary financial conditions (zero-lower bound).

of current and future primary surpluses. The remaining debt is backed by seigniorage revenue. The parameter δ characterizes the degree of independence between fiscal authority and monetary authority: when δ equals 1, fiscal authority backs fully all outstanding debt and there is zero fiscal dominance; when δ equals 0, all outstanding debt is backed by the monetary authority and there is complete fiscal dominance. δ is a 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 nor a commitment formally written in a country's budget, Constitution or central bank organic law. Since the government's intertemporal budget constraint is always satisfied, it follows that:

$$S_t = (1-\delta) i_{t-1} \frac{B_{t-1}}{p_t} \tag{2}$$

a fraction $(1-\delta)$ of the currently outstanding debt plus interests is backed by the present discounted value of current and future seigniorage revenues $\mathcal{S}_t$. The set of possible fiscal regimes is indexed by the fraction δ of the outstanding debt that is backed by the primary surplus.

Using the price equation derived in the Appendix for the money market equilibrium

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

and rearranging terms we get

$$M_t = \frac{\gamma}{(1-\beta)} C_t - (1-\delta) B_t \tag{3}$$

which can be estimated as

$$M_t = \alpha_0 + \alpha_1 C_t + \alpha_2 B_t + \varepsilon_t \tag{4}$$

where $\alpha_1 = \frac{\gamma}{(1-\beta)}, \alpha_2 = -(1-\delta)$ and the parameter δ can be estimated as:

$$\hat{\delta} = 1 + \widehat{\alpha_2} \tag{5}$$

3.1.2 Data and Estimation

The data set used in this estimation is composed of: monetary aggregate (M) where monetary base (MB) and M1 are used for sensitive analysis, private consumption (C), total public sector net debt (B), and gross domestic product (Y). All variables are expressed in billions of UY pesos from 1999Q4 to 2019Q4. Those time series are non-stationary but they can be cointegrated. As M_t, C_t, B_t are endogenous to the model, DOLS (Stock & Watson 1993) are applied.

Dynamic OLS (DOLS) estimation method is used in order to eliminate the feedback in the cointegrating system (Saikkonen 1992, Stock & Watson 1993). DOLS involves augmenting the cointegrating regression with lags and leads of Δx_t so that the resulting cointegrating equation error term is orthogonal to the entire history of the stochastic regressor innovations:

$$M_t = \alpha_0 + \alpha_1 C_t + \alpha_2 B_t + \sum_i^p \alpha_{3i} \Delta C_{t-i} + \sum_i^p \alpha_{4i} \Delta B_{t-i} + \sum_j^q \alpha_{5i} \Delta C_{t+j} + \sum_j^q \alpha_{6i} \Delta B_{t+j} + \epsilon_t \tag{6}$$

Table 4: Fiscal dominance in Uruguay, 1999Q4-2019Q4

Method: Dynamic Least Squares (DOLS) HAC standard errors and covariances				
Dep. Variable Indep. Variable	Monetary Base/GDP		M1 plus saving deposits/GDP	
	Coefficient	*p-value*	*Coefficient*	*p-value*
Consumption/GDP	7.1373	0.0003	3.466	0.0097
Debt/GDP	-0.0492	0.0034	-0.192	0
Constant	-4.1574	0.0005	-1.6769	0.0331
Trend	-0.0091	0.0003	-0.0021	0.266
Adj. R-squared	0.985		0.9839	
SIC criterion: leads	11		9	
lags	11		7	
Sample (adjusted)	2002Q4 2017Q1		2001Q4 2017Q3	
Cointegration tests	*Rejection of null hypothesis of no cointegration*		*Rejection of null hypothesis of no cointegration*	
	0.9508		**0.808**	
Range of at 95%	[0.9268 0.9748]		[0.7864 0.8296]	

Notes: The variables used are expressed in billions of UY pesos and span 1994Q4-2019Q4. The time series are non-stationary but can be cointegrated. Since the monetary aggregate (M_t), private consumption (C_t) and total public sector net debt (B_t) are endogenous to the model, Dynamic OLS are applied. The estimation results suggest a low degree of fiscal dominance. Author's calculations

Both the point estimates and their probability range suggest a mild degree of fiscal dominance, regardless of the monetary aggregate considered although monetary policy independence seems stronger the narrower the definition of money used. The different composition of those monetary aggregates may explain this result. The monetary base refers to the amount of cash circulating in the economy plus commercial bank deposits held in the central bank´s reserves while the monetary supply defined as M1 includes currency in the hands of the public and non-cash assets such as demand deposits. M1 seems a more appropriate choice for measuring fiscal dominance because it encompasses

the entire money supply of the country. Government outstanding debt plus interests can be backed by currency in circulation but not by commercial banks' cash reserves which reduces the importance of base money changes (seigniorage) in the government budget constraint, that is to say, it increases the δ parameter estimate showing a smaller degree of fiscal dominance. On the other hand, all the components of the money supply can back the government outstanding debt (plus interests) which justifies a smaller value for the δ estimate showing less monetary policy independence. Estimation results for Uruguay for 1999-2019 point that the value of the δ coefficient is in the upper range for emerging economies, but still below the values for developed economies, suggesting a low degree of fiscal dominance. Its magnitude is comparable to the point estimate for Mexico (0.80) found by De Resende (2007) for the 1966-2004 period.

3.2 Inflation and Fiscal Deficits

In this section, I build on Catao & Terrones (2005) to analyze the extent to which fiscal deficits affect inflation in Uruguay. Central bank financing of the fiscal deficit could undermine its monetary policy target and be evidence of fiscal dominance.

3.2.1 Methodological Approach

Catao & Terrones (2005) derive a relationship between inflation and fiscal deficits based on a standard macroeconomic model, with a shopping time technology rationalizing the demand for monetary holdings. Empirically, they propose an autoregressive distributed lag (ARDL) econometric model to study the long-run relationship between fiscal deficits and inflation dynamics.

ARDL[14] is a single-equation approach, which suggests that the researcher has a good idea (from theory) regarding which variable is endogenous and which are exogenous. If the variables constitute a system such that all the variables are potentially endogenous, then a full system approach to estimation is preferable. If there are two or more cointegrating vectors, then estimating one in isolation omits influences that might well lead to inconsistent and inefficient estimation. But if there are good theoretical reasons for thinking that two or more of the single equation relationships are sensible, then they should be estimated together, as a system. If there is one cointegrating relationship and certain weak exogeneity results hold then Engle-Granger or ARDL can provide an estimate of the cointegrating relationship. If there are two or more cointegrating relationships Johansen gives an estimate of the space spanned by the cointegrating relationships. If there are two, then any two independent combinations of the two are also cointegrating vectors.

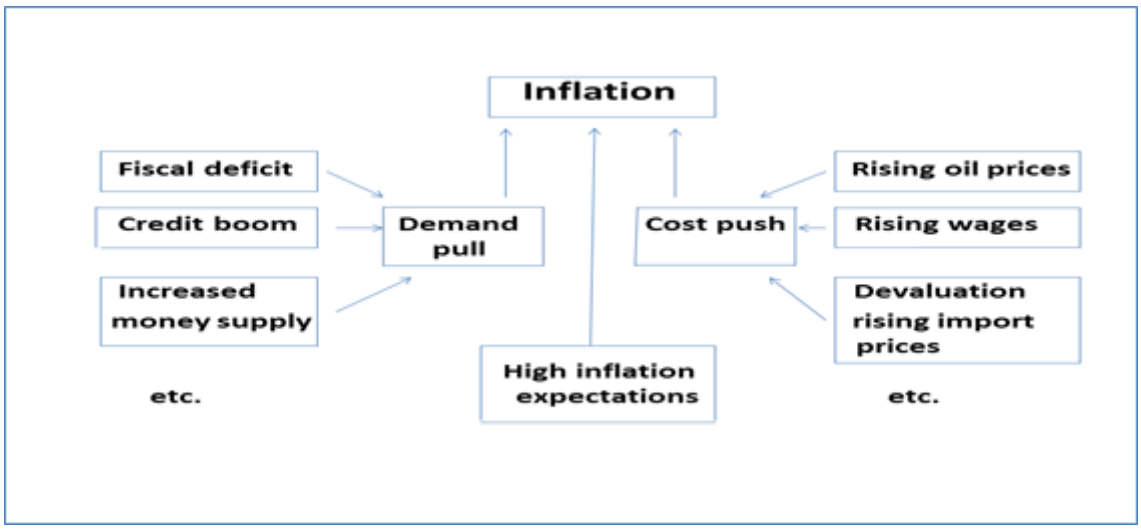
[14] An extensive survey of ARDL models is provided in Banerjee & Hendry (1996). The time-series properties of ARDL models in the estimation of long-run cointegrating relationships are discussed in Pesaran & Shin (1998).

It may be possible to impose conditions arising from our economic theory to identify such linear combinations. In this case the one estimate provided by Engle-Granger or ARDL should lie in (or be "statistically" close to) the Johansen cointegration space and is therefore some linear combination of the Johansen cointegration vectors. Thus, the coefficients have no structural meaning.

The price level is the average of current prices across the entire spectrum of goods and services produced in an economy; it refers to the price or cost of a good, service, or security in the economy. In essence, it refers to the purchasing power of money, that is, how much people can buy with the same unit of currency. The most common price level index is the consumer price index (CPI), a collection of consumer-based goods and services that is examined in aggregate.

Changes in the aggregate price over time push the index measuring the basket of goods higher. Many reasons can cause price changes and economic literature states the main causes of inflation as: *(1) demand pull inflation factors* (e.g., excess aggregate demand, money and credit boom, increase in public spending, positive output gap, etc.); *(2) cost push inflation factors* (e.g., rising wage costs in labour markets, increasing raw material and components costs, rising import costs, etc.); *(3) inflation expectations* (once inflation becomes established and it is difficult to remove most agents will raise their expectations about the evolution of prices in the future and build it into their calculations and decisions); *(4) administered prices*, among others. See Figure (3).

Figure 3: Main causes of inflation: A simple scheme of its most accepted deep roots and driving forces



Notes: Source: author´s design.

Different theories have been developed to explain the roots of inflation, depending on the emphasis put on either its deep causes or its drivers. Each of those theories hinges on the specification of a few stable relations that involve the price level. For instance,

the quantity theory of money states a stable relationship M v=P Y, which implies that the general price level of goods and services is proportional to the money supply in that economy. In an open economy, exchange rate movements impact domestic prices through the prices of traded goods and services (i.e., consumer goods, production inputs, oil, etc.) and this channel is called passthrough: P= E P*. Given that inflation is a complex phenomenon and more than one explanation for the price formation may be true, a straightforward conclusion is that the data generating process of prices validates more than one stable (long-run equilibrium) relationship linking the price level with different economic variables. Consequently, it seems inappropriate to use a single-equation approach to analyze price formation. So, I modify Catao & Terrones (2005)'s model and adapt it to a time series approach in a multi-equation multi-cointegration framework that takes into account more than one long-run relation, diverse sources of consumer price changes and several endogenous variables[15] Let p be the price index (in logs) and x a vector of economic variables that includes fiscal deficits. The VECM (Vector Error Correction Model) that will be estimated — with n correcting vectors CV and k lags for the variables in first differences — has the following structure:

$$\begin{bmatrix} \Delta p_t \\ \Delta x_t \end{bmatrix} = \begin{bmatrix} a_{p0} \\ a_{x0} \end{bmatrix} + \begin{bmatrix} a_{p1} & \dots & a_{pn} \\ a_{x1} & \dots & a_{xn} \end{bmatrix} \begin{bmatrix} CV_1 \\ \dots \\ CV_n \end{bmatrix} + \begin{bmatrix} c_{p1} & \dots & a_{pk} \\ a_{p1} & \dots & a_{xk} \end{bmatrix} \begin{bmatrix} \pi_{t-1} \\ \dots \\ \pi_{t-k} \end{bmatrix} + \begin{bmatrix} h_{p1} & \dots & h_{pk} \\ h_{x1} & \dots & h_{xk} \end{bmatrix} \begin{bmatrix} \Delta x_{t-1} \\ \dots \\ \Delta x_{t-k} \end{bmatrix} + \begin{bmatrix} \epsilon_{pt} \\ xt \end{bmatrix} \tag{7}$$

Recalling that the price index difference Δp_t is the inflation rate π_t, the previous system is:

$$\begin{bmatrix} pi_t \\ \Delta x_t \end{bmatrix} = \begin{bmatrix} a_{p0} \\ a_{x0} \end{bmatrix} + \begin{bmatrix} a_{p1} & \dots & a_{pn} \\ a_{x1} & \dots & a_{xn} \end{bmatrix} \begin{bmatrix} CV_1 \\ \dots \\ CV_n \end{bmatrix}_{t-1} + \begin{bmatrix} c_{p1} \dots & c_{pk} \\ c_{x1} \dots & c_{xk} \end{bmatrix} \begin{bmatrix} \pi_{t-1} \\ \dots \\ \pi_{t-k} \end{bmatrix} + \begin{bmatrix} h_{p1} & \dots & h_{pk} \\ h_{x1} & \dots & h_{xk} \end{bmatrix} \begin{bmatrix} \Delta x_{t-1} \\ \dots \\ \Delta x_{t-k} \end{bmatrix} + \begin{bmatrix} \varepsilon_{pt} \\ \varepsilon_{xt} \end{bmatrix} \tag{7'}$$

This specification is rich enough to allow for different theories of inflation to participate

[15]The single-equation approach clearly distinguishes one endogenous variable from the rest of the variables, which are considered exogenous. That distinction is not possible between prices and other macroeconomic variables which move in a system.

by imposing long-run relationships that are expressed in some of the n cointegrating vectors (i.e., prices may not be included in all CVs). As long as the $(a_{p1} \dots a_{pn})$ parameters are statistically significant and have the correct sign (i.e, they correct the errors), the inflation process can be explained in the long run by the theory encapsulated in such CVs. In addition, provided the $(a_{x1} \dots \ a_{xn})$ parameters are statistically significant and have the correct sign (i.e., they move to restore equilibrium), the x variables react to discrepancies in the long-run relationships which is indicative of endogeneity. In such circumstances a Vector Error Correction (VECM) approach has to be used instead of a single-equation one. The way fiscal deficits and inflation are related is not a trivial one because they are part of a wider macroeconomic system. Impulse-response analysis and variance decomposition are done in order to capture the effects that intertemporal government expenditure management has on inflation.

3.2.2 Data and Estimation

The data is chosen to detect different causes of price changes besides fiscal deficits because by controlling for other sources of inflation the effect of fiscal deficits on inflation could be better measured. The data set is composed of money (M, approximated by M1 plus savings accounts), consumer price index (P), gross domestic product (Y), nominal interest rate (i), nominal exchange rate (UY Pesos/US dollars, E), foreign price index (P*), nominal wage index (W), potential output (Ypot), unemployment rate (μ), openness ratio (total exports plus total imports over GDP, op), fiscal deficit ratio (d, calculated as total Government revenue minus total Government expenses over M), international prices of food (Pf), meat (Pm), soybeans (Ps) and oil (Poil). All variables are expressed in logs of indices (in lower case letters) with base on year 2004 except for interest rate, openness ratio and deficit ratio. The sample expands from 2004Q1 to 2019Q4 because the unemployment rate begins in 2004, reducing the original sample size from 80 to 60 observations. Those time series are non-stationary (some of them with structural breaks) but they can be cointegrated. Several unit root tests were performed and they are displayed in the Appendix.

Johansen test points to five cointegrating vectors (CV_n) among the variables[16]. After a parsimonious process of parameterization, condition imposition and testing, it is possible to identify five stable equilibrium relationships (i.e., all five cointegrating vectors are stationary) with sensible economic meaning. Coefficient estimates are statistically significant at 5 percent and most of them are statistically significant at 1 percent. See

[16]See Appendix. Some variables are finally excluded from the cointegrating vectors, such as openness, international price of oil, of soybeans, of meat and of food. Trend variables are included for the whole period (T_t) and from the year 2013 (DT_2013).

details in the Appendix. They are:

$$m_t/p_t = -13.7875 + 3.2957y_t - 0.03206\ i_t + 0.0091\ d_t - 0.0109\ T_t + \varepsilon_{mt} \tag{8.1}$$

$$e_t p_t^*/p_t = 6.1340 - 0.0193\ d_t - 0.0132\ T_t + \epsilon_{et} \tag{8.2}$$

$$w_t/p_t = -1.9066 + 0.2196\ y_t - 0.0020\ op_t + 0.0076\ T_t - 0.0056\ DT_{2013} + \epsilon_{wt} \tag{8.3}$$

$$y_t = 2.7596 + 0.4305\ p_t - 0.0310\mu_t + 2.7597\ T_t + \epsilon_{y1,t} \tag{8.4}$$

$$y_t = 1.8511 + 0.7264\ y_{pot,t} - 0.1502\ e_t - 0.0012\ op_t + \epsilon_{y2,t} \tag{8.5}$$

Let us explain each cointegrating vector in more detail.

$$m_t/p_t = -13.7875 + 3.2957y_t - 0.03206\ i_t + 0.0091\ d_t - 0.0109\ T_t + \varepsilon_{mt} \tag{8.1}$$

Equation (8.1) summarizes the monetary market: real money balances are demanded by both the public — for transaction and speculative motives — and the government in order to back up a proportion of the fiscal deficit. The long-run income elasticity of real money demand although positive seems somehow larger than standard values while the long-run semi-elasticity of the nominal interest rate to real balances has the expected sign and value. The equilibrium long-run relation suggests that one-point increase in the fiscal deficit ratio would have an impact of 0.9 percent in the annual growth rate of money in real terms. Finally, there is evidence of a demonetization process that reduces the demand for real money at an average rate of 1.1 percent per quarter, mainly owed to the inflation-devaluation close relationship. Portfolio analysis can help in better understanding this phenomenon by considering three interconnected variables: *(i)* the inflation rate, *(ii)* the inflation rate volatility, and *(iii)* the covariance between inflation and devaluation rates. As money is a fixed-rent asset, higher inflation hurts currency and both demand and savings deposits[17] reducing real money demand. In addition, greater inflation volatility is associated with lower real balances demand. Finally, in an open and highly-dollarized economy as the Uruguayan one, inflation movements are closely linked to the evolution of the US dollar currency. Brum et al. (2011) find that transactional money demand is positively associated with the variance of the devaluation rate and negatively related to the covariance between inflation and devaluation rates. That is, three out of four factors are expected to exert down pressure on real balances demand and only one could increase it, i.e., the variance of the devaluation rate.

$$e_t p_t^*/p_t = 6.1340 - 0.0193\ d_t - 0.0132\ T_t + \epsilon_{et} \tag{8.2}$$

Equation (8.2) points to the long-run real exchange rate. It shows a steady fall in

[17] I use M1 plus saving accounts as the operational definition of money.

the last sixteen years at an average rate of 1.3 percent which can be explained by a decline of the American currency with respect to the rest of the currencies together with a domestic inflationary process in excess of foreign inflation. In addition, fiscal deficits seem to be associated with real exchange appreciation[18]. In Uruguay, government revenues are mainly based on tradable goods and services while government expenses are mainly non-tradable. Consequently, a government deficit pushes up non-tradable goods demand increasing their price relatively to that of the tradable goods which may result in real exchange appreciation. In addition, real depreciations can have a positive fiscal impact and government deficits may be negatively associated with the real exchange rate (Romaniello 2008). In effect, in the 2002-2003 crisis, government debt denominated in US dollars jumped and sustainability indicators drastically deteriorated. Contrary to what it could have been expected, the government ran a primary surplus owing to favorable relative prices; furthermore, this effect was so significant that it allowed to back the bulk of interest government debt during those years.

$$w_t/p_t = -1.9066 + 0.2196\ y_t - 0.0020\ op_t + 0.0076\ T_t - 0.0056\ DT_{2013} + \epsilon_{wt} \tag{8.3}$$

Equation (8.3) shows long-run equilibrium in the labor market. Increasing real output goes along with higher real wages and this positive correlation shows the relative easiness of the employers to pay higher wages when the economy is working on a positive phase of the business cycle. On the other hand, greater openness pushes real wages down, which could be indicative of more competition in the labor market once the economy opens up. Finally, the steady increase of real wages since the beginning of the sample slowed down by 2013 (i.e., DT_2013 stands for a dummy variable that behaves as a trend variable since 2013Q1 and takes the zero value otherwise). The growth rate of real wages declined from 0.8 percent per quarter to 0.2 percent on a quarterly basis. The economy decelerated since 2011 causing a slight deterioration in employment and a striking slowdown in the wages growth rate that seems to be captured in equation (8.3).

$$y_t = 2.7596 + 0.4305\ p_t - 0.0310\mu_t + 2.7597\ T_t + \epsilon_{y1,t} \tag{8.4}$$

Equation (8.4) stands for long-run real output. Lower unemployment means more workers in the production process and together with higher prices reflect increases in real output. The positive sign associated with consumer prices is indicative of a supply curve.

$$y_t = 1.8511 + 0.7264\ y_{pot,t} - 0.1502\ e_t - 0.0012\ op_t + \epsilon_{y2,t} \tag{8.5}$$

[18]There is a bidirectional relation between government deficits and real exchange movements that may become clear soon.

Equation (8.5) depicts another long-run relationship that involves real output. Higher potential output enables higher real growth while openness and nominal devaluation dump real output. As imported inputs are more expensive after a devaluation and fewer of them are bought and included in the production process, the final real output can be harmed.

In sum, the existence of more than one cointegrating vectors discards the ARDL model approach. Had the latter been used, a linear combination of the five long-run relationships (8.1)-(8.5) would have been found but without any sensible structural meaning. Those five long-run relationships are backed by statistically significant error correction terms for certain variables while the rest of them are weakly exogenous. Table (5) summarizes those results.

Table 5: Weak exogeneity summary based on the statistical significance of the error-correcting coefficient (a_{jn} , where j=p, x, and n =1 to 5)

Error-correcting vector	p	m	i	e	p*	w	y	y_{pot}	d	op	μ
1 (money market)	X	X									
2 (real exch. rate)	X								X		
3 (labor market)						X					
4 (goods market)	X										
5 (goods market)							X				

Notes: For each variable, it was checked the statistical significance of the error-correcting coefficient associated with each error-correcting vector, α_{jn}.The symbol "X" means that the coefficient is statistically significant and the corresponding variable is not weakly exogenous in that long-run relationship; as a result, this variable adjusts when a disequilibrium appears in that long-run relationship. Besides: (a) consumer prices are endogenous not only in the money and in the goods markets but also in the real exchange rate relationship, (b) government deficits are endogenous in the long-run real exchange rate determination. Source: author's calculations.

Determining Factors of the Price Level in the Long Run

Relevant conclusions can be drawn from the cointegrating vectors found and the results summarized in Table (3): *(1)* consumer prices keep four stable relationships with different macroeconomic variables that can be interpreted as equilibrium long-run relationships; *(2)* consumer prices adjust in three out of four of those relationships favoring certain theories of price formation; *(3)* only money and prices respond to disequilibria in the money market; *(4)* fiscal deficit can affect money market equilibrium but does not respond by adjusting any monetary imbalance; *(5)* fiscal deficit only reacts (together with consumer prices) to balance real exchange rate misalignments while nominal exchange rate and foreign prices are exogenous; *(6)* nominal wage is the only variable that gets back to restore equilibrium in the labor market; *(7)* real output only moves if a disequilibrium appears in the goods market; *(8)* prices and real output are the ones that restore

equilibrium in the goods market; *(9)* money does not balance real output disequilibria in the short run; *(10)* potential output, nominal exchange rate, foreign prices, openness, nominal interest rate and unemployment rate seem to be weakly exogenous to the five equilibrium relationships.

These findings suggest that at least in the last two decades inflation has not been exclusively a monetary phenomenon and that other plausible theories of price formation can be applied to explain the Uruguayan case. The quantity theory of money relies on two basic propositions: proportionality between money growth and inflation and long-run neutrality between money growth on the one hand and output growth and velocity changes on the other. Both of them are found in this investigation (equation 8.1) which validates the traditional quantity explanation of price formation in the long run. The passthrough from exchange rate movements to domestic prices through the prices of traded goods and services (e.g., consumer goods, production inputs, oil, etc.) is also supported by the results of the present investigation (equation 8.2). Finally, the market-clearing mechanism moves the price level to restore equilibrium in the goods market (equation 8.4). Furthermore, the estimates show some kind of influence of fiscal policy on monetary policy because consumer prices increase when fiscal deficit pressures money market equilibrium (equation 8.1). This outcome gives some support to the fiscal theory of price level (FTPL), that is, fiscal deficits do induce inflation pointing to a certain degree of fiscal dominance. In addition, monetary policy may affect fiscal policy through real exchange rate movements induced by price changes (equation 8.2).

Determining Factors of the Price Level in the Medium and Short Run

The ***price equation*** estimate is:

$$\Delta p_t = 0.032 + \begin{pmatrix} 0.0640 \\ 0.0980 \\ 0.2390 \end{pmatrix}$$

$$\begin{pmatrix} -1.00 & 1.00 & 0.03 & 0.00 & 0.00 & 0.00 & -3.30 & 0.00 & -0.01 & 0.00 & 0.00 & 0.00 & 0.11 & 13.79 \\ -1.00 & 0.00 & 0.00 & 1.00 & 1.00 & 0.00 & 0.00 & 0.00 & 0.02 & 0.00 & 0.00 & 0.00 & 0.01 & -6.13 \\ -0.43 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 1.00 & 0.00 & 0.00 & 0.00 & 0.03 & 0.00 & 0.00 & -2.76 \end{pmatrix}$$

$$\begin{pmatrix} p \\ m \\ i \\ e \\ p* \\ w \\ y \\ y\ pot \\ d \\ op \\ \mu \\ DT_{2013} \\ Trend \\ Const \end{pmatrix}_{t-1} + \sum_{j=1}^{2} A_j \begin{pmatrix} \Delta p \\ \Delta m \\ \Delta i \\ \Delta e \\ \Delta p* \\ \Delta w \\ \Delta y \\ \Delta y\ pot \\ \Delta d \\ \Delta op \\ \Delta \mu \\ \Delta DT_{2013} \\ \Delta Trend \\ \end{pmatrix}_{t-j} + \epsilon_{xt} \quad (8)$$

where Aj is the matrix of autoregressive coefficients.

In the short and medium terms, price dynamics include the influence of all the variables considered in the present investigation , because prices are part of an autoregressive system. For that reason, it is useful to perform impulse-response analysis to get a description of the evolution of prices along a timespan after a one-time shock. In particular, my main interest is to see the reaction of prices (e.g. inflation) when government finances worsen. Figures (4) and (5) illustrate that situation.

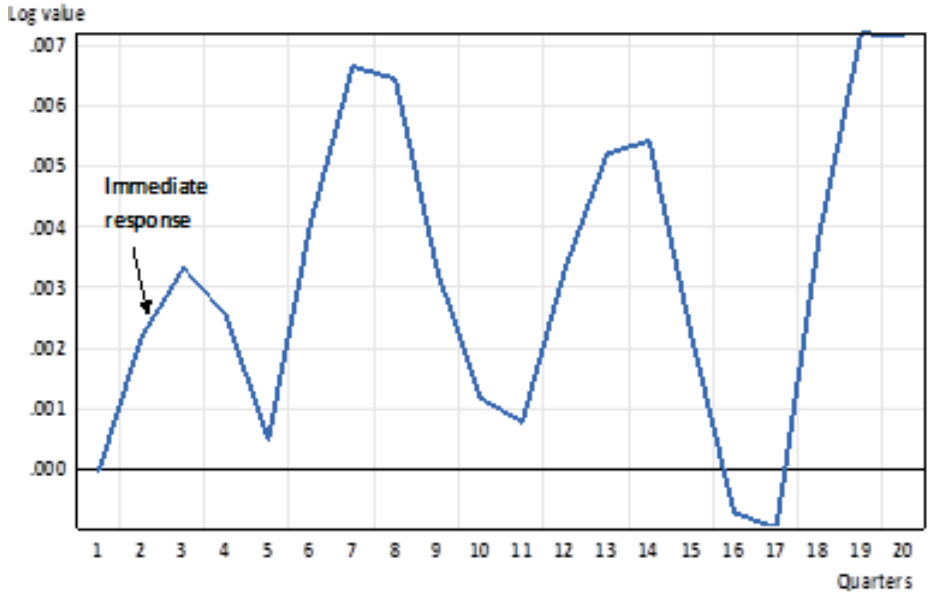
The *impulse response* analysis[19] shows that a one-time increase in the fiscal deficit ratio of one standard deviation (s.d.), induces a positive reaction on consumer prices (inflation) of 0.25 percent the following quarter (see Figure 4).

A one-time increase in the ratio of fiscal deficit to GDP of one standard deviation, accumulates an increase in inflation of 0.90 percent in a year adding up to 6.40 percent in a five-year span – a Presidential term. These results point to inflationary financing. See Figure (5).

While an impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variable in the VECM, *variance decomposition* separates the variation in an endogenous variable into the component shocks to the system. Thus, the variance decomposition provides information about the

[19]If the innovations are contemporaneously uncorrelated interpretation of the impulse response is straightforward. The i-th innovation is simply a shock to the i-th endogenous variable innovations. However, they are usually correlated, and may be viewed as having a common component which cannot be associated with a specific variable. In order to interpret the impulses, it is common practice to apply a transformation to the innovations so that they become uncorrelated. I use Generalized Impulses transformation as described by Pesaran & Shin (1998) that constructs an orthogonal set of innovations that does not depend on the VAR ordering.

Figure 4: Uruguay: fiscal result and annual inflation rate, 1999-2019.
In percentage rates



Notes: Impulse-response analysis of the evolution of consumer prices to a fiscal deficit increase along 20 quarters. A one-time increase in the fiscal deficit ratio of one standard deviation induces a positive reaction on inflation of 0.25 percent the following quarter. Source: author´s calculations.

relative importance of each random innovation in affecting the variables in the VECM. As with the impulse responses, the variance decomposition based on the Choleski factor can change dramatically by altering the ordering of the variables in the VECM.

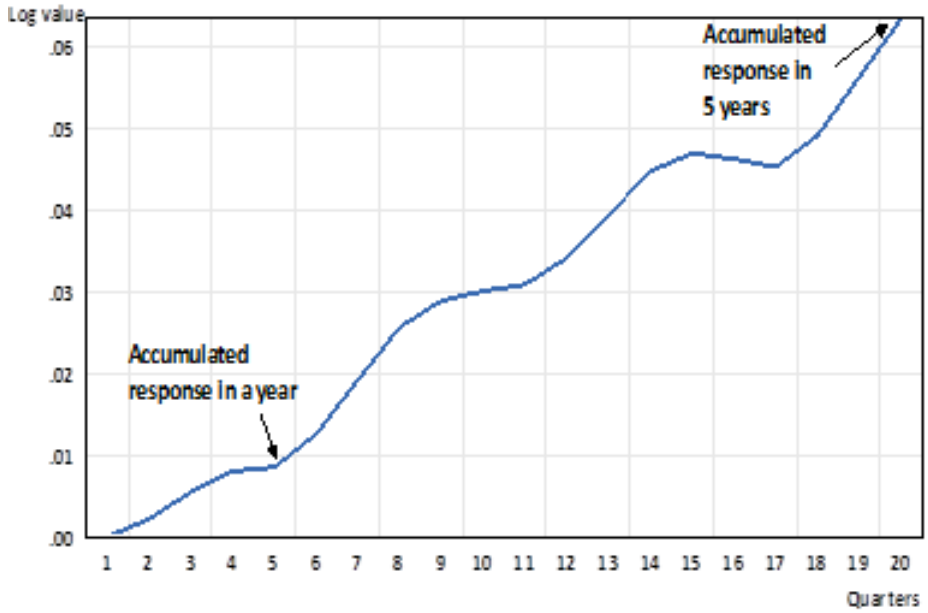
Table 6: Variance decomposition of prices. Based on the multicointegration approach

Period	**s.e.**	**Prices**	**Fiscal deficit**	**Money**	**Exch. rate**	**Foreign prices**	**Wages**	**Output**	**Others**
1	0.0045	100	0	0	0	0	0	0	0
2	0.0067	74.5	5.05	0.77	0	0.56	8.34	6.67	4.11
3	0.0104	42.03	7.67	9.72	3.32	1.11	8.25	7.16	20.74
4	0.0152	36.45	5.9	7.5	8.73	1.68	6.92	6.01	26.81
5	0.0203	39.68	3.58	4.36	11.92	2.93	4.67	6.29	26.57
6	0.0255	35.91	4.97	3.21	11.11	3.24	3.03	8.46	30.07
7	0.03	29.55	7.12	3.33	11.61	2.52	2.19	13.57	30.11
8	0.0337	26.96	8.42	3.41	12.16	2	1.74	16.33	25.98
9	0.0366	26.4	7.66	3.45	12.67	1.75	1.62	17.6	25.85
10	0.0395	27.23	6.78	3.02	12.1	2.03	1.48	17.58	29.78

Notes Relative importance of innovarions in affecting the VECM variables. Choleski Ordering: p, M, i, e, p*. w, y, y_pot, d, openness, μ, DT_2013. Source: author´s calculation.

Price inertia becomes apparent in the variance decomposition of prices and the relative importance of fiscal deficit seems to be rather stable at around 6 percent of prices standard error, regardless of the ordering of the variables. This value persists under different Choleski orderings. The other variables have varying relative importance: while money and wages decline nominal exchange rate and output gain more leadership.

Figure 5: Uruguay: fiscal result and annual inflation rate, 1999-2019.
In percentage rates



Notes: Accumulated response of consumer prices to a fiscal deficit increase. A one-time increase in the ratio of fiscal deficit to GDP accumulates a 0.90 percent increase in inflation in a year and adds up to 6.40 percent in a five-year span. Source: author´s calculations.

4 Concluding Remarks

Macroeconomic policy design is not a simple task. Monetary and fiscal policies have to be coordinated in order to maintain macroeconomic stability and avoid welfare losses. The distinction between Ricardian and non-Ricardian regimes is a useful tool for understanding the difficulty of the monetary policy in achieving low and stable inflation. Nevertheless, this difference is not only a theoretical exercise to enhance the understanding of economic policy but a widely applied device related to good practices and accountability. The global COVID-19 pandemic has called for heightened levels of policy intervention stressing government accounts and amplifying their impact on the macroeconomy through an already nonexistent fiscal space. Policymakers' choices during this disruption may shape the economy for decades to come.

The present investigation is aimed at providing a degree of fiscal dominance in Uruguay using a quarterly dataset from 1999Q1 to 2019Q4 exploiting the relationship between fiscal and monetary policy through the intertemporal government's budget constraint. This identity links present and future government deficits and actual government debt (plus interests) with present and future seigniorage. One way to address the issue — following De Resende (2007) — is to concentrate on fiscal sources and try to quantify the fraction of fiscal expenditures that is financed by monetary liabilities (1-δ).

The measure of actual fiscal dominance in Uruguay that is found for the last 21 years

is not directly related to the formal structure that regulates monetary and fiscal relations. Actually, it is more related to 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 nor a commitment formally written in the country's budget, Constitution or central bank organic law. Nevertheless, the institutional arrangement where fiscal and monetary policies take place is highly correlated with the degree of actual fiscal dominance.

Another approximation to the fiscal dominance issue is to analyze the effects of fiscal deficits on the price level and inflation. When persistent government deficits are balanced with central bank money higher inflation pulled by money increases may result and it may jeopardize central bank's inflation target. As a result, monetary policy may be subordinated to fiscal policy. In order to isolate the effect of fiscal deficits on inflation Catao & Terrones (2005)'s model is adapted to a time series approach in a multi-equation multi-cointegration framework that takes into account more than one long-run relation and diverse sources of consumer price changes. As a byproduct of this study evidence is provided on the determining factors of the price level (inflation) over the period of review. **The results suggest that inflation is not exclusively a monetary phenomenon. In particular, fiscal deficits do induce inflation suggesting a certain degree of fiscal dominance.**

This investigation points to **a relatively low degree of fiscal dominance at least in the last twenty-one years**. The δ point estimate of 0.8080 is in the range of [0.7864 0.8296] with 95 percent of certainty. Fiscal deficits had a positive effect on consumer prices although (on average) they explain only 6 percent of consumer price variance. This result is in line with those of Bucacos (2003) and Marandino & Oddone (2018) who found a declining influence of inflationary finances in Uruguay since the 1970s and especially after 1991 — owing to significant macroeconomic measures such as the opening of the economy, financial liberalization, greater access to external financing, stabilization plans, and the more restrictive institutional framework of the central bank. In particular, the limit imposed on the assistance the Central Bank of Uruguay (BCU) could offer to the rest of the public sector[20] translates into an average value of 0.955 for the δ coefficient. This implies that theoretically, seigniorage could only back on average 4.5 percent of Government's outstanding debt plus interests while (according to our results) the Government´s willingness to do so is around 19.2 percent. This gap implies that **there is room for improvement on both fiscal and monetary authorities' behaviors** through a cultural change that enhances the social value of policy coordination instead of dominance of one policy over the other.

Monetary policy independence does not guarantee per se low and stable inflation nor

[20]Legal provisions enshrined in the BCU Act (1995) limit the stock of public debt the central bank could hold to 10 percent of the primary budget of the previous year.

the existence of a fiscal rule (i.e. public debt limitations) guarantees good fiscal results. Coordination between fiscal and monetary policies is needed and, in addition, monetary policy must not be subordinated to the fiscal authority and the fiscal policy has to avoid non-Ricardian regimes (Christiano & Fitzgerald 2000). In that sense, a flexible fiscal rule gives the fiscal authority a wedge to respond to unexpected shocks while keeping its political compromise of fiscal responsibility. Fiscal discipline allows the fiscal authority to gain credibility. Latin America in general and Uruguay in particular share a long history of high inflation rates together with significant fiscal deficits that were financed by money issuing. As a result, monetary policy had low credibility.

The good news is that

> "... there is an uncoupling between fiscal deficits and inflation. Better institutions break fiscal dominance, help central banks to gain credibility and let them pursue countercyclical monetary policy."
>
> (Vegh 2020)

Movements towards more transparency such as the ones recently implemented by the Central Bank of Uruguay — i.e., the change of monetary policy instrument, the increase in the frequency of Monetary Policy Committee (COPOM in Spanish) meetings — seem to be in the right direction in order to gain more credibility in central bank performance and help to stabilize prices.

References

Aiyagari, S. R. & Gertler, M. (1985), 'The backing of government bonds and monetarism', *Journal of Monetary Economics* **16**(1), 19–44.

Banerjee, A., D. J. G. J. W. & Hendry, D. (1996), 'Co-integration, error correction, and the economic analysis of non-stationary data', *The Economic Journal* **106**, 439.

Brum, C., Bucacos, E. & Carballo, P. (2011), 'La demanda de dinero en una economía dolarizada: Una estimación para uruguay', *Revista de economía* **18**(2), 101–127.

Bubula, A. & Otker-Robe, I. (2002), 'The evolution of exchange rate regimes since 1990 evidence from de facto policies'.

Bucacos, E. (2003), 'El financiamiento inflacionario del déficit fiscal', *Documento de trabajo* **2**(03).

Catao, L. A. & Terrones, M. E. (2005), 'Fiscal deficits and inflation', *Journal of Monetary Economics* **52**(3), 529–554.

Christiano, L. J. & Fitzgerald, T. J. (2000), Understanding the fiscal theory of the price level, Technical report, National bureau of economic research.

De la Plaza, L. & Sirtaine, S. (2005), *An analysis of the 2002 Uruguayan banking crisis*, The World Bank.

De Resende, C. (2007), Cross-country estimates of the degree of fiscal dominance and central bank independence, Technical report, Bank of Canada Working Paper.

Farmer, R. E. & Zabczyk, P. (2019), A requiem for the fiscal theory of the price level, Technical report, National Bureau of Economic Research.

Kehoe, T. J., Nicolini, J. P. & Sargent, T. (n.d.), 'A framework for studying the monetary and fiscal history of latin america, 1960–2017'.

Licandro, G. (2000), 'Las reglas de responsabilidad fiscal en el uruguay.'.

Licandro, G. & Vicente, L. (2006), 'Incentivos fiscales e inconsistencia temporal: Uruguay 1970-2005', *Documento de trabajo del Banco Central del Uruguay* pp. 1–2006.

Marandino, J. & Oddone, G. (2018), 'The monetary and fiscal history of uruguay: 1960-2017', *University of Chicago, Becker Friedman Institute for Economics Working Paper* (2018-60).

Paolillo, C. (2004), *Con los días contados*, Editorial Fin de Siglo.

Pesaran, H. H. & Shin, Y. (1998), 'Generalized impulse response analysis in linear multivariate models', *Economics letters* **58**(1), 17–29.

Rial, I. & Vicente, L. (2003), 'Sostenibilidad y vulnerabilidad de la deuda pública uruguaya: 1988-2015', *Revista de economía* **10**(2), 143–220.

Romaniello, G. (2008), El efecto del tipo de cambio real en la solvencia fiscal, PhD thesis, Tesis de Maestría en Economía Internacional, tutor: Umberto Della Mea ....

Saikkonen, P. (1992), 'Estimation and testing of cointegrated systems by an autoregressive approximation', *Econometric theory* pp. 1–27.

Sargent, T. J., Wallace, N. et al. (1981), 'Some unpleasant monetarist arithmetic', *Federal reserve bank of minneapolis quarterly review* **5**(3), 1–17.

Sims, C. A. (1994), 'A simple model for study of the determination of the price level and the interaction of monetary and fiscal policy', *Economic theory* **4**(3), 381–399.

Stock, J. H. & Watson, M. W. (1993), 'A simple estimator of cointegrating vectors in higher order integrated systems', *Econometrica: Journal of the Econometric Society* pp. 783–820.

Vegh, C. (2020), Institucionalidad para la política monetaria, xxxv jornadas anuales de economia, Technical report, Banco Central del Uruguay.

Woodford, M. (1994), 'Monetary policy and price level determinacy in a cash-in-advance economy', *Economic theory* **4**(3), 345–380.

Woodford, M. (1998), Public debt and the price level, Technical report, Citeseer.

Appendix

A The Budget Constraint Approach

The budget constraint of the government is:

$$B_t + P_t b_t + E_t B_t^* + M_t = P_t(D_t + T_t) + B_{t-1}R_{t-1} + P_t b_{t-1} r_{t-1} + E_t B_{t-1}^*$$

where: $B_t,\ b_t,\ B_t^*$ are nominal, indexed and dollar denominated debt, D_t is government deficit in real terms, measured as expenditures and normal transfers minus taxes, M_t is the stock of money, P_t is the domestic price level, and E_t is the nominal exchange rate. $R_{t-1},\ r_{t-1},$ and $B*_{t-1}$ are the gross returns on nominal, inflation indexed, and foreign currency bonds. The term T_t is a residual that makes the budget constraint hold.

The real exchange rate is:

$$\xi_t = \frac{E_t P_t^w}{P_t}$$

where P_t^w is the price level for the dollar denominated debt. Then,

$$\xi_t(\frac{B_t^* P_t^w}{y_t}) = \frac{E_t P_t^w}{P_t}(\frac{B_t^* P_t^w}{y_t}) = \frac{E_t B_t^*}{P_t y_t}$$

is the value of the dollar denominated debt as a fraction of nominal GDP.

Let us define

$\theta_t^N = \frac{B_t}{P_t y_t},\ \theta_t^r = \frac{b_t}{y_t},\ \theta_t^* = \frac{B_t^* P_t^*}{Y_t}, m_t = \frac{M_t}{P_t y_t}, d_t = \frac{P_t D_t}{P_t y_t},\ \tau_t = \frac{P_t T_t}{P_t y_t}$

and

$\xi_t = \left(\frac{E_t P_t^*}{P_t}\right),\ g_t = \frac{Y_t}{Y_{t-1}}, \pi_t = \frac{P_t}{P_{t-1}},\ \pi_t^w = \frac{P_t^w}{P_{t-1}^w}$

The budget constraint expressed in terms of changes as fractions of GDP is

$$(\theta_t^N - \theta_{t-1}^N) + (\theta_t^r - \theta_{t-1}^r) + (\xi_t\theta_{t-1}^* - \xi_t\theta_{t-1}^*) + (m_t - m_{t-1}) + m_{t-1}(1 - \frac{1}{g_t\pi_t}) =$$
$$\theta_{t-1}^N(\frac{R_{t-1}}{g_t\pi_t} - 1) + \theta_{t-1}^r(\frac{r_{t-1}}{g_t} - 1) + \xi_t\theta_{t-1}^*(\frac{R_{t-1}^*}{g_t\pi_t^w} - 1) + d_t + \tau_t$$

Finally, the sources of funds can be seen on the left hand-side: increases in debt-to-output ratios in the three different types of debt: nominal, indexed, and foreign currency; increases in high-powered money, and seigniorage. The uses of funds are on the right hand-side: the service costs on each of the three debt types which are discounted by growth of GDP and deflated by the corresponding price index – that is, the nominal debt service costs by domestic inflation and the foreign debt service costs by US inflation. These adjustments account for the reductions in ratio of debt to GDP caused by GDP growth and inflation. The final two terms on the right-hand side represent the fiscal

deficit — including the extraordinary transfers T — as a fraction of output.

B The De Resende (2007) Model

Consumers

Consumers are identical, infinitely-lived with perfect foresight (not crucial but analytically convenient) and maximize utility function u

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

where $\beta\ in\ (0,\ 1$, and u is increasing in all arguments, strictly concave, twice continually differentiable and satisfies INADA conditions. It is assumed a logarithmic and separable instantaneous utility function:

$$u\left(c_t, m_t p_t, 1 - n_t\right) = ln\left(c_t\right) + \gamma \ln\left(m_t p_t\right) + \theta\ ln(1 - n_t)$$

Their budget constraint is:

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

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 periods t-1 and t. In equilibrium $r_t = i_{t-1}\ \pi_t$. They satisfy a No-Ponzi condition. FOCs are:

- Euler eq. for consumption

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

- Money demand

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

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

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 constraint:

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

That is,

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 $\delta - backing$ fiscal policy is a sequence $\{G_{y+j}, \tau_{t+j}, B_{t+j}\}_{j=0}^{\infty}$ such that, for all t:

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

A constant fraction (δ) of the outstanding Government debt + interests, is backed by the present discounted value of current and future primary surpluses. Since the government's intertemporal budget constraint 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 plus 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.

Equilibrium

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

1. The representative consumer and the representative firm optimize given the government policy and the price system;

2. The government policy is budget-feasible given the price system and the choices of consumers;

3. Markets clear.

The price level is determined by the clearing of the money market: $M_t = m_t$

Money Supply

It is 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. Combining money demand and money market equilibrium condition:

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

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

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

So, the price level depends on:

1. Consumption
2. The money stock
3. 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

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

$$\alpha_1 = \frac{\gamma}{(1-\beta)}, \qquad \alpha_2 = -\left(1-\delta\right), \qquad\qquad \rightarrow \quad \hat{\delta} = 1 + \widehat{\alpha}_2$$

$M_t,\ C_t,\ B_t$ are endogenous to the model and nonstationary variables but they can be cointegrated.

C Data

Table 7: Variable definition for fiscal dominance regressions

Variable name	**Definition**	**Source**
MB	Monetary Base	Central Bank of Uruguay
M	M1 plus savings accounts	Central Bank of Uruguay
P	Consumer Price Index	National Statistics Institute
Y	Gross Domestic Product	Central Bank of Uruguay
C	Private Consumption	Central Bank of Uruguay
B	Total public sector net debt	Central Bank of Uruguay
i	1-90 day nominal passive interest rate	Central Bank of Uruguay
E	UY pesos/US dollars	Central Bank of Uruguay
P*	Weighted average of UY commercial partners' CPI	Central Bank of Uruguay
W	Private nominal wages index	National Statistics Institute
Ypot	UY potential output, average of different methods	Central Bank of Uruguay
μ	Total unemployment rate	National Statistics Institute
X	Exports of goods and services	Central Bank of Uruguay
Im	Imports of goods and services	Central Bank of Uruguay
T	Total revenues of Government	Central Bank of Uruguay
G	Total expenses of Government	Central Bank of Uruguay
P*_food	International price of food	FRED
P*_meat	International price of meat	FRED
P*_soybean	International price of soybean	FRED
P*_oil	International price of oil	FRED

Table 8: Descriptive statistics regression variables

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
MB/Y	0.202476	0.210329	0.259858	0.130873	0.033587	81
M/Y	0.378106	0.403404	0.521967	0.192002	0.108661	81
C/Y	0.722714	0.724243	0.813684	0.59776	0.041058	81
B/Y	1.441024	1.209997	3.251183	0.827069	0.59848	81
P	5.593563	5.573646	6.193029	5.033013	0.352453	64
Y	4.896986	4.95375	5.150894	4.486787	0.197868	64
i	4.80277	5.05087	7.726772	1.442646	1.525009	64
E	5.343199	5.319085	5.766659	5.075216	0.181432	64
P*	4.78937	4.793551	4.991628	4.478975	0.128576	64
W	5.628325	5.6508	6.41019	4.76398	0.5107	64
Ypot	4.915943	4.965409	5.145361	4.567881	0.189372	64
μ	8.709531	8.245	13.9	6.11	1.9927	64
openness	37.22635	38.44167	56.06158	22.98017	7.423329	64
G-T	-5.215497	-4.266624	4.84768	-19.64759	5.244357	64
P*_food	5.130511	5.136824	5.390201	4.807917	0.15885	64
p*_meat	5.175353	5.291205	5.659084	4.731668	0.248539	64
p*_soybean	5.267836	5.271098	5.804013	4.658861	0.282464	64
p*_oil	5.445691	5.405837	6.064549	4.746611	0.318757	64
p*	4.78937	4.793551	4.991628	4.478975	0.128576	64

Table 9: Probability values for unit root tests of variables in levels

	Augmented Dickey-Fuller		Phillips-Perron		Breakpoint	
	Intercept	Intercept and trend	Intercept	Intercept and trend	Intercept	Intercept and trend
MB/Y	0.5692	0.4043	0.1298	0.0069	0.2821	0.4656
M/Y	0.7437	0.7959	0.7321	0.1023	0.6858	0.6927
C/Y	0.5672	0.0302	0	0	0.001	0.001
B/Y	0.3887	0.0713	0.4486	0.4628	0.001	0.001
P	0.9997	0.3543	1	0.8954	0.991	0.0305
Y	0.0227	0.9968	0.7603	0.0056	0.1152	0.991
i	0.1659	0.0906	0.2236	0.1074	0.1411	0.365
E	0.9402	0.796	0.9043	0.8401	0.8856	0.9769
P*	0.1186	0.5298	0.1185	0.5484	0.7996	0.9167
W	0.0303	0.9952	0.3833	0.6041	0.1058	0.991
Ypot	0.0283	0.7133	0.0286	0.9995	0.02	0.2285
μ	0.3277	0.9598	0.0621	0.7861	0.1247	0.6482
openness	0.7797	0.03	0.03	0.0002	0.5616	0.131
G-T+ints	0.0156	0.0114	0	0	0.001	0.001
P*_food	0.2597	0.8221	0.2106	0.7329	0.4508	0.59
p*_meat	0.5118	0.4073	0.5092	0.4215	0.0349	0.1361
p*_soybean	0.4386	0.8183	0.344	0.7155	0.2308	0.216
p*_oil	0.2208	0.4914	0.2835	0.6698	0.5566	0.6287