# Financing fiscal deficits. Intertemporal approach under different exchange rate regimes

Ricardo Luis Descalzi, Ángel Enrique Neder

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# Financing Fiscal Deficits. Intertemporal approach under different exchange rate regimes

**Ricardo Descalzi[1] and Á. Enrique Neder[2]**
Universidad Nacional de Córdoba, Argentina

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## ABSTRACT

Financing fiscal deficits implies different effects on economic variables, particularly depending on the instrument used to fund those deficits. If these economic measures do not generate impacts on welfare, they would not be of concern. But, undoubtedly, they do provoke them. And, in the special case of Argentina, the main concern is focused on the impacts of inflation, which can deteriorate the real income of families and, consequently, their welfare.

Additionally, the impacts would be different considering the exchange rate regime that is being applied.

Using a cash-in-advance model (which consists on holdings of foreign exchange in advance) for a small open economy with seigniorage and following McCandless (2008) and Descalzi and Neder (2015 and 2016), we found a long run relationship between inflation, money issuing, nominal exchange rate and fiscal deficit, meaning that inflation, nominal exchange rate and the government imbalances are driven by the same trend.

In this paper, we emphasize the impacts using different exchange rate regimes (fixed and flexible exchange rate).

[1] Facultad de Ciencias Económicas. Universidad Nacional de Córdoba. Av. Valparaíso s/n. Córdoba (5000). E-mail: ricdes@eco.uncor.edu.

[2] Facultad de Ciencias Económicas. Universidad Nacional de Córdoba. Av. Valparaíso s/n. Córdoba (5000). E-mail: enrique.neder@eco.uncor.edu.

# I Introduction

Financing fiscal deficits implies different effects on economic variables, particularly depending on the instrument used to fund those deficits. If these economic measures do not generate impacts on welfare, they would not be of concern. But, undoubtedly, they do provoke them. And, in the special case of Argentina, the main concern is focused on the impacts on inflation, which can deteriorate the real income of families and, consequently, their welfare. While this is not bad news, as is pointed out by Bucacos (2003), given that it would lead to a first step to find genuine sources to finance fiscal deficits, in order to avoid distortions in the economy, such distortions would still remain.

Uribe (2016), considering the Sargent and Wallace's *unpleasant monetarist arithmetic*[3], and using a Money in the Utility Function model, presents three options to finance the fiscal deficit depending on the expected path for it: If the fiscal deficit remains constant over the time, it will be desirable for the government to finance it completely with seigniorage. If the fiscal deficit follows a growing trend, in principle it would be desirable for the central bank to generate seigniorage over that necessary level to finance that deficit at that time and the difference to use it to rescue part of the debt that in the future will follow a growing path as the deficit increases. And the third option is that if the fiscal deficit follows a decreasing trend, it will be convenient for the government to use seigniorage to finance only part of the deficit and the rest to cover debt issuance.

In our case, we use a cash-in-advance model (henceforth CIA). These models are characterized by the requirement of previous existence of money held by people to be applied for consumption. The form of the CIA constraint depends on which transactions are considered to be included in that constraint (Walsh, 2010). As in Descalzi and Neder (2015 and 2016), and following McCandless (2008), we use an extended CIA model modifying the traditional one[4], and introducing a real government budget constraint, but considering in the CIA restriction the holdings of foreign exchange which are used to be applied for consumption. In other words, even though transactions are made in local currency, people, in advance, think about the need of having the foreign currency to fulfill those transactions. This means, they think, in advance, about the maintenance of their purchasing power. Thence, they demand foreign money in

[3] See Sargent and Wallace (1981).
[4] A good description of CIA models can be revised in Walsh (2010).

advance which will be changed into local currency to pay for goods and services (tradables and non-tradables). This is in line with Lucas (1982), who established that agents make an allocation of their portfolios between cash and other assets at the start of a considered period prior to buy goods and services. This means that assets markets open before goods markets and if agents detect an opportunity cost of holding money, they will only hold a sufficient amount to finance their desired level of consumption.

In this paper, we assume that a *de facto* bi-monetary pattern exists, and we are interested in determining the long run relationship between fiscal deficit, money growth, and inflation rate in a small open economy (SOE), at the time we deal with different exchange rate regimes. To achieve this objective, we raise three issues strongly related to the field of Development Economics: First, we state the existence of goods and services tradable and non-tradable, setting a level of consumption which is the main element of welfare for the individuals. Second, we introduce the domestic demand of foreign currency into the optimization process, to interpret the actual feelings of population who save in foreign currency to avoid a collapse in their consumption level, revealed in the loss of purchasing power. Third, we also consider the impact on inflation rate and money demand of the two most known exchange rate regimes: fixed vs. flexible. We work with a model that which includes funding the fiscal deficit not only from issuing money, but also foreign public debt. So, in the nominal budget constraint for families, these two variables will be considered, as the nominal exchange rate as well.

Following Obstfeld and Rogoff (1996) we propose a model in which the real exchange rate is determined by real fundamentals. However, this enables us to handle a simple pass-through scheme, in which the domestic inflation fully impact on the nominal exchange rate. In this case, the first order conditions would indicate that when the Government decides financing its deficit by issuing money, the optimal exchange policy is to let the nominal exchange rate to float. Only if the inflation rate equal zero (and thus, the public accounts are balanced) the optimal exchange rate policy corresponds to a nominal fixed exchange rate regime.

We try to resemble an economy which is not confident on the value that the local currency will have in the future. Thence, the representative agent decides to save in units of foreign currency.

In fact, we assume that local residents are aware that government will run a fiscal deficit which will be financed issuing money, provoking inflation. Because of this, we suppose a cash-in-advance scheme in which local residents, rather than saving in local currency, they save in foreign currency.

As a result, we obtain that the demand for real balances depends on the inflation rate. The higher the inflation rate, the lower the demand for real balances. However, under our approach and following Bayley (1956), we obtain the standard result that the seigniorage is an increasing function of the inflation (the well-known Bayley's curve).

The remain of the paper is organized as follows. In next section, we present a *de facto* bi-monetary system. In section III we develop the government budget constraint and analyze the extraction of seigniorage, giving values to some parameters to simulate a behavior for Argentina. Section IV includes some results for the relationship between debt and inflation rate. In the last section, we present some concluding remarks. The references are shown at the end of the paper.

## II A model to represent a *de facto* bi-monetary system

In this model the existence of families, companies, government (which is taken in an integrated way, by simplification, with the central bank) and an external sector is considered. Families face a restriction that determines the demand for funds in advance that is both, in domestic and in foreign currency, to carry out their transactions. Companies have a production function for tradable and non-tradable goods and they relate to families through labor and capital holdings.

The scheme of operation of the model is as follows: the central bank issues domestic currency that is transferred to the government who finances its expenditure through seigniorage and these funds go to families. On the other hand, the government takes foreign debt, obtaining foreign currencies that are transferred to the central bank against the consequent issuance of domestic currency or culminate being demanded and maintained by families. Due to the cash-in-advance restriction that families face, it is clear that the government has a liability in foreign currency and that families use those currencies to carry out their transactions.

We assume that residents demand foreign currency in the period *t-1* to purchase nominal consumption goods in *t*:

$$P_t C_t = e_t(B^*_{t-1} - B^P_{t-1}) \quad (1)$$

where $P_t$ is a price index in *t*, $C_t$ is the real consumption index in *t*, $e_t$ is the nominal exchange rate in *t*, $B^{*,t-1}$ represent the stock of foreign currency accumulated by local residents at time *t*−1, and $B^{P,t-1}$ is the (net) stock of foreign assets that local residents hold at time *t*−1. However, we specifically assume that this variable represents the units of foreign currency hoarded by local residents. In summary, rather than saving in foreign "bonds" that could render an interest, the local residents demand dollars "in advance" (sacrificing the interest payments) to purchase goods in the next period. It represents the fact that in emerging SOE the foreign currency is used as a *numeraire* and a mean of payment or hoarding. In this way, local residents try to maintain the real value of their income by "saving in dollars", speculating (or betting) against the local currency by holding foreign currency, but with a clear aim: not losing purchasing power. Why is it supposed that local residents will use local currency if it is going to depreciate? The answer is because of legal enforcement. In this paper, we assume that in period *t* local residents sell their stocks of foreign currency to buy domestic money and fulfill the legal requirements, at least at some extent. In order to get the assumed amount of domestic currency needed to buy non-tradable goods, we assume a composite consumption good conformed by the aggregation of consumption of tradables ($C_T$) and non-tradables ($C_N$), with proportion η and 1-η, respectively.

$$C = \Psi(C_T, C_N) = C_T^{\eta} - C_N^{1-\eta} \quad (2)$$

Maximizing *C* subject to the total production (in nominal terms) $Y=P_T C_T+P_N C_N$, it renders the optimal demands for consumption of tradable goods $C_T = \left(\frac{1}{\eta}\right)^{\eta}\left(\frac{1}{1-\eta}\right)^{1-\eta}\eta\left(\frac{P_T}{P_N}\right)^{1-\eta}C$, and of non-tradable goods $C_N = \left(\frac{1}{\eta}\right)^{\eta}\left(\frac{1}{1-\eta}\right)^{1-\eta}(1-\eta)\left(\frac{P_T}{P_N}\right)^{\eta}C$. The general price index *P* follows from replacing the optimal demands in the index $P$, obtaining the indirect utility function. By considering that *PC*=*Y*, the resulting index equals to $P = \left(\frac{1}{\eta}\right)^{\eta}\left(\frac{1}{1-\eta}\right)^{1-\eta}P_T^{\eta}P_N^{1-\eta}$. Then, $P_N C_N=(1-\eta)PC$ and $P_T C_T=\eta PC$.[5] Thus, the amount of domestic currency that individuals demand at time *t* is related to the nominal expenditure in non-tradable goods:

[5] For further details see Obstfeld and Rogoff (1996).

$$P_{N,t}C_{N,t} = M_t \qquad (3)$$

The model is completed by considering the budget constraint for the families:

$$\left(P_{T,t}Y_{T,t}+P_{N,t}Y_{N,t}\right) + e_tB^*_{t-1}(1+i^*_t) - e_tB^P_{t-1}(1+i^*_t) + M_{t-1} = \left(P_{T,t}C_{T,t}+P_{N,t}C_{N,t}\right) +$$
$$+e_tB^*_t - e_tB^P_t + M_t$$

where $Y_{T,t}$ and $Y_{N,t}$ represent the production of tradable and non-tradable, respectively. The international (risk-free) interest rate is represented by $i^*$.

We assume that individuals rather than allocating their savings in external assets that earn interest rate, they maintain their balances of foreign assets liquid to afford the next period level of consumption. Thus, the restriction for the families is:[6]

$$\left(P_{T,t}Y_{T,t}+P_{N,t}Y_{N,t}\right) + e_tB^*_{t-1} - e_tB^P_{t-1} + M_{t-1} = \left(P_{T,t}C_{T,t}+P_{N,t}C_{N,t}\right) + +e_tB^*_t - e_tB^P_t + M_t \qquad (4)$$

Operating in real terms, and adding to the output the level of real investment (which is considered to be applied only for tradable goods), we get

$$(r_tK_t + w_tL_t) + \frac{M_{t-1}}{P_t} + \frac{P_{T,t}}{P_t}K_t = \frac{e_t}{P_t}(B^*_t - B^P_t) + \frac{M_t}{P_t} + \frac{P_{T,t}}{P_t}K_{t+1} \qquad (5)$$

where $r_t$ is the real interest rate expressed in terms of tradable goods, and $w_t$ is the real wage under the assumption of equal salary levels between tradable and non-tradable goods. From equation (5) we can get the level of hours worked in the economy:

[6] This expression could be re-arranged to express the external restriction faced by the whole economy as follows: Given that $PC = e_tB^*_{t-1} - e_tB^P_{t-1}$, the restriction resumes to:

$$\left(P_{T,t}Y_{T,t}+P_{N,t}Y_{N,t}\right) + M_{t-1} = e_tB^*_t - e_tB^P_t + M_t$$

and

$$\left(P_{T,t}Y_{T,t}+P_{N,t}Y_{N,t}\right) + M_{t-1} = e_tB^*_{t-1} - e_tB^P_{t-1} + M_{t-1} + e_t\Delta B^*_t - e_t\Delta B^P_t + \Delta M_t.$$

Since the nominal Government expenditure is financed by debt and issuing money:

$$P_{N,t}G_t = -e_t\Delta B^P_t + \Delta M_t,$$

the previous equation is defined as:

$$P_{T,t}Y_{T,t} - P_{T,t}C_{T,t} = e_t\Delta B^*_t$$

given that $P_{N,t}Y_{N,t} = P_{N,t}C_{N,t} + P_{N,t}G_t$.

$$L_t = \frac{\frac{e_t}{P_t}\left(B_t^* - B_t^P\right) + \frac{M_t - M_{t-1}}{P_t} + \frac{P_{T,t}}{P_t}K_{t+1} - \left(r_t + \frac{P_{T,t}}{P_t}\right)K_t}{w_t} \tag{6}$$

Thus, the optimization problem is defined as follows:

$$\underbrace{max}_{M_t, B_t^*, K_{t+1}} \quad V_t = \sum_{t=0}^{\infty}\{Ln(C_t) + \Lambda L_t\} \quad \text{where } \Lambda < 0$$

Subject to:

$$P_t C_t = e_t(B_{t-1}^* - B_{t-1}^P)$$

$$P_{N,t} C_{N,t} = M_t$$

$$P_{N,t} C_{N,t} = (1 - \eta) P_t C_t$$

$$P_{T,t} C_{T,t} = \eta P_t C_t$$

$$L_t = \frac{\frac{e_t}{P_t}\left(B_t^* - B_t^P\right) + \frac{M_t - M_{t-1}}{P_t} + \frac{P_{T,t}}{P_t}K_{t+1} - \left(r_t + \frac{P_{T,t}}{P_t}\right)K_t}{w_t}$$

The first-order condition for $M_t$ is:

$$\frac{M_t}{P_t} = -\frac{w}{\Lambda}\frac{(1+\pi_{t+1})}{\frac{(2-\eta)}{(1-\eta)}(1+\pi_{t+1}) - 1} \tag{7}$$

In steady state, inflation rate determines real balances. This means that they are not fixed, but depends on the expected rate of inflation $\pi_{t+1} = \frac{P_{t+1}}{P_t}$ in a negative way. The higher the rate of inflation, the lower the demand for real balances. This even validates the behavior assumed for economic agents to demand foreign currencies in advance, in order to protect their purchasing power.

The first-order condition for $B^{*,t}$ is:

$$\frac{P_{t+1}}{P_t} = \frac{e_{t+1}}{e_t} \tag{8}$$

Thus, in the steady state the inflation rate must be equal to the devaluation rate. In other words, the model suggests that optimal monetary policy implies in the steady state a fixed real exchange rate $\frac{e_t}{P_t} = \frac{e_{t+1}}{P_{t+1}} = \frac{e}{P}$ . In other words, there should exist a complete pass-through. This is also in line with the behavior of the agents. They demand in advance foreign currencies for doing their transactions and with the aim of not losing purchasing power.

Finally, the first-order condition for $K_{t+1}$ in the steady state is:

$$r_{t+1} = \frac{e}{P}(P_t^* - P_{t+1}^*) \qquad (9)$$

Being $P_t^*$ the international price of the tradable goods. Thus, the return of the capital diminishes as the price of tradable goods increases. This behavior would be like that observed with any other type of investment, for example a bond.

## III The Government Budget constraint and the seigniorage

In this section, we develop the part of the model in which local residents maintain in their portfolios, desired stocks of foreign currency to finance their future consumption. Rather than utilizing domestic currency to back their transactions, they speculate by holding foreign money "in advance" and exchanging it for "pesos" at the time of affording transactions that legally require the use of domestic money.

The main consequences of this scheme are that individual's demand for real balances depends negatively on the (long-run) inflation rate. When considering the government budget restriction, it can be seen that the government has two financing sources. It can borrow from abroad to reduce the fiscal gap (this source is more efficient as wider the gap between $\pi$ and $B^P$ ). The remaining tool to meet the fiscal requirement relies on the seigniorage. The real fiscal expenditure is positively associated to the creation of real balances, which in turn in this model, is positively linked to the long-term rate of inflation. In other words, it is supposed that government income, arising from collecting inflationary tax, is positively related to the long-term rate of inflation.[7]

Assuming that the government consumption is only composed of non-tradable goods, the nominal budget constraint for the government is defined as follows:

$$P_{N,t}G_t = -e_t[B_t^P - B_{t-1}^P(1 + i_t^*)] + \Delta M_t \qquad (10)$$

Where $P_{N,t}$ is the price for non-tradable goods and services, and $G_t$ is the public government expenditure. The fiscal expenditure can be financed by two means: on the one hand, government can issue a risk-free rate bond $B_t^P$ at time *t*, paying an (international) interest rate

[7] In this case, we would not be in the presence of the Laffer curve.

$i^{*,t}$.[8] It is assumed that the government sells the foreign currency obtained by the credit to local residents;[9] so, $B^{P,t}$ also would represent the stock of foreign currency held by individuals that has been obtained by hoarding the money get from the government throughout the credit operations.

On the other hand, government expenditure can also be financed by issuing money. The second term of the previous equation represents the seigniorage collected by the government, defined as the real value of the increase in the nominal stock of money. The expenditure expressed in terms of non-tradable goods is:

$$G_t = \frac{-e_t\left[B_t^P - B_{t-1}^P(1+i_t^*)\right] + \Delta M_t}{P_{N,t}} \tag{11}$$

or:

$$G_t = \frac{-e_t\left[B_t^P - B_{t-1}^P(1+i_t^*)\right]}{P_{N,t}} + \frac{M_t - M_{t-1}}{P_{N,t}} \tag{11a}$$

Finally, we obtain the government expenditure in terms of the general price index ($P_t$):

$$\frac{P_{N,t}G_t}{P_t} = -e_t\left[\frac{B_t^P}{P_t} - \frac{B_{t-1}^P}{P_{t-1}}\frac{(1+i_t^*)}{(1+\pi_t)} + \left(\frac{M_t}{P_t} - \frac{M_{t-1}}{P_{t-1}}\frac{P_t}{P_{t-1}}\right)\right] \tag{12}$$

In the steady state:

$$g(\pi, B^P) = -B^P\frac{e}{P}\left[1 - \frac{1+i^*}{1+\pi}\right] + \frac{M}{P}(\pi)\left(1 - \frac{1}{1+\pi}\right) \tag{13}$$

and replacing for the demand for real balances:

$$g(\pi, B^P) = -B^P\frac{e}{P}\left[1 - \frac{1+i^*}{1+\pi}\right] - \frac{W}{\Lambda}\frac{\pi}{\frac{(2-\eta)}{(1-\eta)}(1+\pi) - 1} \tag{13a}$$

In the long term, the government real expenditure depends on the stock of debt issued by the government and destinated to the international markets ($B^P$ is the value of the debt in the long run) and also depends on the long-run inflation rate (π). It can be shown that $g(\pi, B^P)$ around the steady state, responds negatively to changes in the $B^P$. This means that as $B^P$ increases (i.e. the government improves its net financial position) the fiscal deficit

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[8] Since we consider a SOE, $i^{*,t}$ is given.

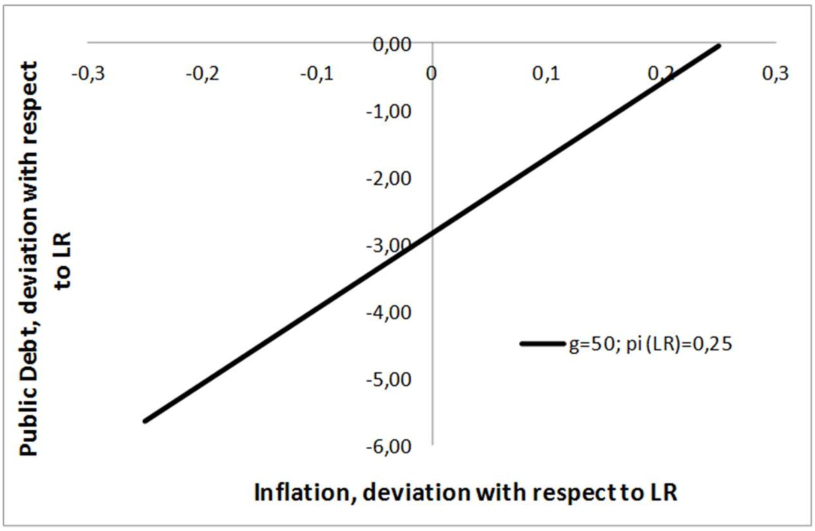
[9] In another way, these international reserves could enter to the central bank and then be sold to the economic agents.

accentuates. This result could appear as surprising, and it is conditioned to the (long-term) relationship between π and $i^*$. Actually, if $\pi > i^*$ the government benefits from getting foreign funds abroad as high inflation tends to deteriorate the real value of the interest payments.[10] It is necessary to emphasize that this process shows how the government accumulates debt at the same step that the individuals rise (demand) their stocks of foreign currency.

On the other hand, $g(\pi, B^P)$ is positively related to inflation rate in the long term, as expected. The government takes advantage of issuing money at the expense of diminishing individual's real balances and consumption, as well.[11]

By taking first-order linear approximation of $g(\pi, B^P)$ the relationship between debt and inflation can be assessed. Additionally, values for the remaining parameters are proposed.[12] Figure 1 shows that there is a positive relationship between π and $B^P$. If the policy strategy is aimed at increasing $\pi_t$ (with respect to its long-term value), which means that Central Bank satisfies the government needs issuing money, there will be a (transitory) negative shock in the public debt, under the assumption that $\pi > i^*$. That is to say, if additional revenue is obtained by increasing seigniorage, the government no longer needs a high level of indebtedness.

Figure 1: **Relationship between public debt and inflation**




[10] This is a kind of "leverage effect" given by the fact that the interest payments rises at a rate $i^*$ while prices increase at a greater pace given by the inflation rate π.

[11] The closed-form for consumption is defined as $C_t = \frac{1}{1-\eta}\frac{M_t}{P_t}$. Thus, an increase in prices reduces the real balances and the consumption.

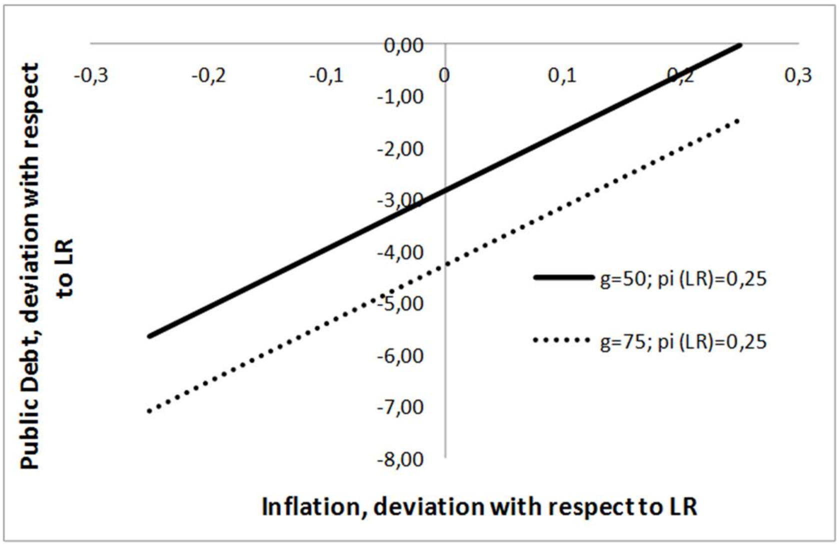
[12] We utilize the following long-run values for the parameters: $-\frac{w}{\Lambda} = 1$, η=0.5, $i^* = 0.03$, π=0.25, $\frac{e}{P} = 100$, $g = 50$.

In this sense, the greater the seignorage, the higher the inflation rate. And from equation (8), the existence of flexible rate will promote this policy.

In Figure 2 we develop two examples. First, we consider a hike in the long-run level of public expenditure. The dotted line represents a level of public expenditure higher than that represented by the full line (both of them have the remaining parameters in same levels). It can be seen that if $g$ increases, the line representing the tradeoff between $B^p$ and $\pi$ moves down: when $g$ increases, a higher level of inflation is needed (given a certain level of $B^P$) to collect a greater level of seigniorage. Alternatively, a higher level of indebtedness should be acquired to finance an increase in the level of real government expenditure. This could be in line with the scenario presented by Bianchi and Melosi (2017), where the economic agents expect that policymakers (considering the Fiscal and the Monetary authorities) will follow non-coordinated policies. This means that we will be in presence of both, Fiscal and Monetary active policies. Fiscal authority keeps postponing the needed adjustment, while the Monetary authority commits to raise interest rates in order to fight against inflation. This lack of coordination could drive to a huge increase in external debt (according to the behavior of economic agents) and also to generate large fiscal imbalances that could finally converge in a crisis.

**Figure 2**

**Relationship between public debt and inflation for different long-run values of real government expenditure**



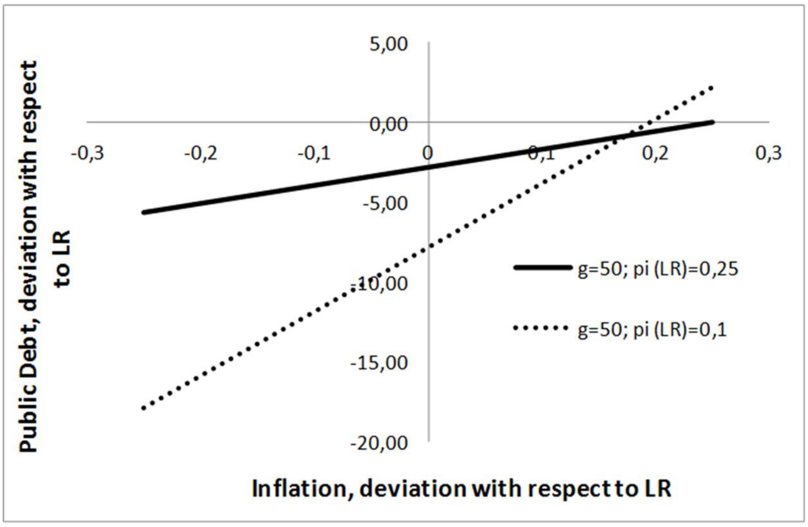
This model suppose that exchange rate is flexible (varying at the same pace that inflation rate), but we can ask ourselves if it would be possible a situation where the exchange rate regime implies a fixed rate. In this case, the inflation rate should be very low (or zero).

Finally, in Figure 3 we account for differences between the inflation and international interest rate (the level of public expenditure remains constant in this case). The dotted line shows a small gap between $i^*$ and $\pi$ with respect to the baseline example. This means that when the inflation is lower the strategy of borrowing from abroad is "less efficient" than the seigniorage (if the gap is "small" the government is not able to take advantage of "leveraging"). As the inflation increases, the external net position of the government improves at a faster pace in the case the gap is smaller (the dotted line is steeper).

**Figure 3**

**Relationship between public debt and inflation**

**Effectiveness of seigniorage as dependent of the gap between inflation and international interest rate**




In this case, the monetary authority could follow a less restrictive policy, allowing a high level of inflation rate in the long run.

# IV Results for the long-run relationship between the inflation and the public debt

The theoretical analysis suggests that the inflation and the public debt are correlated in the long-run. The higher the steady-state inflation rate, the lower the optimal long-run stock of public debt. We gather evidence on this theoretical issue by performing the following estimation strategy. Firstly, we carry out the unit root test to assess the stationarity of the inflation and the public debt; secondly, a cointegration test is driven to analyze whether these variables are cointegrated; finally, we fit a vector error correction model and impose structural identifying restrictions to compute the transition of the public debt to its new long-run value following an inflation shock.

Variables are expressed in logarithms. Table 1 shows the unit root tests carried out to analyze the stationarity of inflation and the public debt. It can be seen that the null hypothesis of unit root cannot be rejected in both cases.

**Table 1**
**Augmented Dickey-Fuller test**

| Variable | Deterministic Variable | Number of lags (differences) | t-statistic | Critical values (1%) | Critical values (5%) | Critical value (10%) |
|---|---|---|---|---|---|---|
| D_log | C | 7 (AIC, FPE, HQ) | 0.7791 | -3.43 | -2.86 | -2.57 |
| D_log | C | 0 (SC) | -0.9182 | -3.43 | -2.86 | -2.57 |
| pi_log | - | 1 (SC) | -0.9082 | -2.56 | -1.94 | -1.62 |
| pi_log | - | 6 (SC) | -1.6347 | -2.56 | -1.94 | -1.62 |

Source: Own calculations.

Table 2 explores whether inflation and public debt are cointegrated. Results associated to the Johansen´s test indicate that these variables could exhibit a common long-run stochastic trend.

**Table 2**
**Johansen Cointegration Test (λtrace statistic)**

| Test | Included lags (levels) | H0 | LR | Critical Values | | |
|---|---|---|---|---|---|---|
| | | | | 90% | 95% | 99% |
| **Johansen** | 1(AIC, FPE, HQ, SC) | r=0 | 20.64 | 17.98 | 20.16 | 24.69 |
| | | r=1 | 1.01 | 7.60 | 9.14 | 12.53 |

Source: Own calculations.

We move now to estimate the cointegration relations $\beta' Y_{t-1}$. Under the assumption that a cointegrating vector exists, we estimate the cointegration equations $ec_{t-1}=\beta' Y_{t-1}$, so that:

$$\boldsymbol{D}_{t-1}=-\beta_{11}\pi_{t-1}$$

It is expected that $-\beta_{11}$ be negative: if the (long run) inflation rate increases (raising the inflationary tax), the public debt diminishes. The estimated coefficients are shown in Table 3. All the variables are expressed in logarithms, so that the coefficients are elasticities. Given that in the cointegration equations all the variables are in the RHS, for a right interpretation of the coefficients, the sign of the elasticities should be inverted.

**Table 3**
**Coefficients of cointegration relations $\beta' Y_{t-1}$**
**$Y_{t-1} = (\boldsymbol{D}_{t-1}, \pi_{t-1})'$**

| Cointegration Equation | Coefficients of the cointegrating vector β: | |
|---|---|---|
| | $\boldsymbol{D}_{t-1}$ | $\pi_{t-1}$ |
| $Ec_{1,t-1}$ | **1.000** | 0.978 |
| | **(0.000)** | (0.152) |
| | **{0.000}** | {0.000} |
| | **[0.000]** | [6.444] |

(Std. Dev.) {p - Value} [t - Value] *** p<0.01, ** p<0.05, * p<0.1.
The Akaike, Final Prediction Error, Hannan-Quinn and Schwarz Criteria indicated that the optimal VAR lag length is equal to 1. The cointegration test was run using Johansen (Trace) and Lütkepohl and Saikkonen (L&S) procedures. The null hypothesis H0: rank (β) = 1 cannot be rejected, so that the VEC was specified assuming that the cointegration rank is equal to 1. Remaining VEC's specification details are as follows: deterministic variables: CONST S1 S2 S3 TREND, endogenous lags (in differences): 1, sample range: [2004 Q2, 2017 Q1], T = 52, estimation procedure: One stage. Johansen approach. Further estimation details are available upon request. Estimations were carried out using J-Multi.
Source: Own calculations.

The estimated coefficient for the response of (the log of) the public debt to the (log of) the inflation rate is found to be negative ($-\beta 11<0$) and significantly different from zero, as expected. It can be inferred that when inflation increases by 1% the public debt should increase by almost the same percentage to maintain constant the fiscal budget restriction in the long run. Finally, in what follows we check the overall consistency of the fitted VECM by adjusting the impulse-response function throughout a structural decomposition. The vector of endogenous variables can be decomposed to consider short and long effects of the shocks in the following way (Lütkepohl et al; 2004):

$$\mathbf{Y}_t = \Xi \sum_{i=1}^{t} \boldsymbol{\mu}_{t-1} + \Xi^*(L)\boldsymbol{\mu}_t + \mathbf{Y}_0^*$$

To identify the shock, we impose a zero-restriction on the matrix that reflects the short-run responses, given by $\mathbf{B}$. Given that:

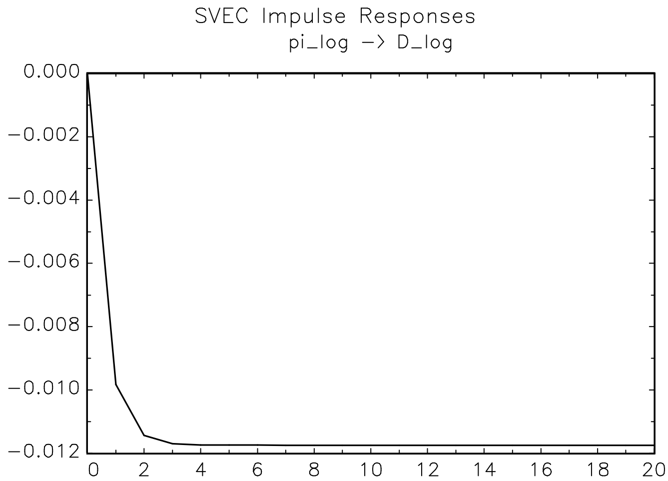
$$\varepsilon_t = [\varepsilon_t^D \quad \varepsilon_t^\pi]'$$

we suggest the following structure:

$$\mathbf{B} = \begin{bmatrix} * & \mathbf{0} \\ * & * \end{bmatrix}$$

where $\boldsymbol{\mu}_t = \mathbf{B}\boldsymbol{\varepsilon}_t$. The statistical appendix shows the estimates of the long- and short-run impact matrices $\Xi\mathbf{B}$ and $\mathbf{B}$ respectively. Finally, the Figure 4 displays the response of the public debt to a one-standard deviation shock in the inflation rate.

**Figure 4**
**Response of D to π**




Source: Own calculations.

The public debt responds negatively to a shock in the inflation, as expected. In the third quarter, the stock of public debt achieves its new long-run value.

# V Concluding remarks

In this paper, we put forward the problem that in emerging small open economies residents decide to flight capital because they try to shelter from a government who run high fiscal deficits. Local residents try to protect themselves by avoiding taxes (being involved in an informal economy) and by accumulating huge stocks of foreign currency. At the same time, they expect domestic money to depreciate and they struck a singular accord with the government. Rather than issuing money to finance fiscal deficits, the government borrows funds from abroad, thus providing foreign currency to local residents, who demand these stocks to finance future consumption.

The residents do not apply these stocks to buy foreign assets; they simply maintain these stocks to protect their purchasing power, sacrificing interest earnings. Our setting presents two alternative ways to finance the real public expenditure: government can either finance the expenditure by issuing debt or by seigniorage. The first procedure tends to preserve the real consumption (as it depends negatively upon the long-term inflation rate), providing additional stocks of foreign currency. However, if the gap between the long-term inflation rate and the international interest rate is “small", the seigniorage is more effective, lowering also the burden of the debt.

There is a kind of wicked game between economic agents and government: the former allows, in a lenient way, the indebtedness by the government, in order to get in advance the foreign currency needed to carry their transactions without a loss in purchasing power. The existence of flexible exchange rate and the consequence complete pass-through is a requirement to “seal the deal”.

# Appendix

Estimated **B** matrix

| | |
|---|---|
| 0.0538 | 0.0000 |
| 0.0149 | 0.3720 |

Bootstrap standard errors:

| | |
|---|---|
| 0.0186 | 0.0000 |
| 0.0447 | 0.0373 |

Bootstrap t-values:

| | |
|---|---|
| 2.8966 | 0.0000 |
| 0.3341 | 9.9819 |

Estimated **long run impact matrix**

| | |
|---|---|
| 0.0516 | -0.0117 |
| -0.0528 | 0.0120 |

Bootstrap standard errors:

| | |
|---|---|
| 0.0174 | 0.0084 |
| 0.0178 | 0.0086 |

Bootstrap t-values:

| | |
|---|---|
| 2.9637 | -1.3921 |
| -2.9637 | 1.3921 |

SigmaU~*100

| | |
|---|---|
| 0.2899 | 0.0803 |
| 0.0803 | 13.8633 |

end of ML estimation

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