Optimal taxation and debt composition: Is Monetary Policy Too Costly?

Gerardo Licandro
Optimal taxation and debt composition: Is Monetary Policy Too Costly?(*)

Gerardo Licandro-Ferrando
Banco Central del Uruguay

First draft: May 2000

Abstract

Using an optimal taxation model, in which inflation and inflation variability are tied together, we are able to determine that the incentives to generate inflationary surprise backfire, increasing the cost of debt. When we require plans to be time consistent, we find that, although the policymaker would rather set inflation to international standards, this target is not part of any time consistent equilibrium. In order to achieve the Pareto-improving zero-inflation outcome the government needs to resort to commitment mechanisms. It is shown that an optimal selection of the debt-portfolio results in better outcomes by reducing the base of the inflation tax, but some inflationary bias persists as long as the national currency exists. With a debt portfolio in which nominal debt is incorporated, in order to achieve the zero-inflation Stackelberg equilibrium the country needs to commit to zero inflation.

(*) Las opiniones vertidas en este trabajo son de responsabilidad exclusiva de su autor y no comprometen la posición institucional del Banco Central del Uruguay.
I.- Introduction.

The traditional literature on optimal taxation highlights the incentives of governments to generate a positive inflation rate to finance a portion of the budget deficit (include references). This result has survived a strong wave of criticism towards the use of monetary policy to target.

Using an optimal taxation model, in which inflation and inflation variability are tied together, we are able to determine that the incentives to generate inflationary surprise backfire, increasing the cost of debt. When we require plans to be time consistent, we find that, although the policymaker would rather set inflation to international standards, this target is not part of any time consistent equilibrium. In order to achieve the Pareto-improving zero-inflation outcome the government needs to resort to commitment mechanisms. It is shown that an optimal selection of the debt-portfolio results in better outcomes by reducing the base of the inflation tax, but some inflationary bias persists as long as the national currency exists. In order to achieve the zero-inflation Stackelberg equilibrium the country needs to commit to zero inflation. It is argued that in the case of a country subject to intense lobbying pressure and bad reputation on inflation stabilization such commitment can only arise from the renouncement to sovereign monetary policymaking.

The paper proceeds as follows. Section two describes the basic setup and recreates the traditional optimal taxation approach; section three introduces currency risk, section four makes currency risk endogenous and section five concludes.
II.-The Model.

The setup is basically similar to Calvo and Guidotti (1992) and Goldfajn (1997). It is a two period model in which a government, after deciding the portion of period 1’s budget deficit to be financed with debt, chooses the optimal mix of policy instruments in order to finance period 2’s budget. There are two types of bonds available: those denominated in nominal national currency, and those denominated in foreign currency. The government can pay out public spending and debt either with regular taxes or through the inflation tax. The problem of the government can be summarized as

\[
\text{(1.) Min } V = \mathbb{E} \left[ A \frac{\tau^2}{2} + \frac{\pi^2}{2} \right] \text{ such that } \\
\text{(2.) } \tau = g + B \left( \theta \frac{1 + i + (1 - \theta) \frac{(1 + i^*) (1 + e)}{1 + \pi}}{1 + \pi} \right) \frac{k\pi}{1 + \pi}
\]

Where \( \tau \) represents the tax instruments available to the government, \( \pi \) stands for inflation, \( g \) represents the (stochastic) government spending, \( B \) is total debt, \( i \) is the national currency denominated interest rate, \( e \) is the devaluation rate and \( i^* \) is the international rate of interest. \( A \) is the relative cost of inflation in terms of taxes, and \( \theta \) is the portion of debt in nominal domestic currency.

According to the cost function depicted in (1), the government does not like to use any tax instrument to close the budget deficit. Note that the quadratic form implies that the government does not like positive values of inflation or taxes. In a more attractive interpretation, \( g \) can be thought of as the stochastic component of the budget deficit, and \( \tau \) as the instruments the government has in the margin to pay this component. In this
interpretation, core taxes are considered net in g. In this setup, having $\tau^2$ as an argument of the cost function implies that the government does not like to increase taxes.

Consumers are introduced in a very simple manner, in this first stage they are assumed risk neutral. In later sections we will relax this assumption to allow for some risk aversion on the consumer side.

\[(3.) \quad 1 + i = \left(1 + i^*\right)
\]

The timing of the game proceeds as follows. The game starts once the amount of debt financing has already been decided. The government then chooses an optimal composition of debt according to the costs implied by the interest rates asked by the private sector. Once the debt has been issued, the government determines optimal inflation. Then the shocks on the real exchange rate and public spending are observed and finally the budget gap has to be shut down with tax instruments.

---

gov. decides $\theta$  p. s. sets exp  shocks

\[
\begin{align*}
B \text{ is set. } & & \text{gov. sets } \pi & & \text{taxes are levied}
\end{align*}
\]

We will assume the government is following a exchange rate rule.

\[(4.) \quad \pi = e + q\]

where $q$, the real exchange rate, is assumed to be a white noise, i.e, PPP holds.

---

**II.1.1 Time consistent solution without commitment.**

After shocks are realized, the government has to solve the fiscal gap by raising taxes, i.e.,

\[(5.) \quad \tau = g + B\left[1 - \theta(\pi - \pi^e) - (1 - \theta)(q - q^e)\right] - k\pi.\]
Before shocks occur, the government chooses the optimal devaluation rate by minimizing the cost function subject to the prior expression. In time consistent equilibria, the government cannot fool the private sector in equilibrium, so the inflation rate equals the expected inflation rate, so it can be shown that

\[ \pi_{NC} = \frac{A(g + B)(B\theta + k)}{1 + Ak(B\theta + k)}. \]

Since the cost function depends on the devaluation rate only through the inflation rate, we concentrated on the minimization of \( V \) w.r.t. \( \pi \). Notice that optimal inflation is, as expected, increasing in the share of public debt denominated in national currency. This result derives from the fact that with rational expectations, the private sector recognizes the incentives to generate inflation by the government. In equilibrium the government is not able to reduce the cost of the debt on national currency.

**II.2 Time consistent solution with commitment.**

What would be the inflation rate the government would like to commit to under rational expectations, i.e. time consistent expectations? To find that value, we have to minimize \( V \), incorporating before doing the first order conditions the restriction imposed by the information structure. In other words, the government recognizes it would not be able to fool the private sector beforehand and solves its problem accordingly. The optimal inflation rate in that case reduces to

\[ \pi^C = \frac{Ak(g + B)}{1 + Ak^2}. \]

It can be easily shown that \( \pi_{NC} > \pi^C \).
Two main conclusions can be drawn from the previous results. In first place, as long as there is a monetary base there will be a fiscal incentive to generate inflation (devaluation). However, rules, as a fixed exchange rate arrangement, would help to reduce the inflationary bias, turning the pair monetary-exchange rate policy more stable. Second, the dollarization of public sector debt helps disciplining the government even in the absence of rules.

Additionally, it is worth noting that the existence of a national currency with bad reputation, i.e. with a policymaker that places low weight on inflation control, will generate excessive costs in terms of the interest rates paid. Eliminating the ability of the policymaker to generate inflation would reduce the interest rates paid, reducing the cost of inflation stabilization.

III. Currency risk and the cost of national debt.

Now we turn to consider the incentives of the policymaker when there is a currency premium on nominal, home currency denominated debt. The private sector is assumed to demand national bonds as long as the following non-arbitrage condition hold.

\[
1 + i = \left(1 + \frac{i}{1 + e}\right) \left(1 + e^*\right) (1 + p)
\]

With this specification, it is straightforward to show that

\[
\pi^{nc} = \frac{A(g + B(1 + \theta p))(B\theta + k)}{1 + A\theta (B\theta + k)}
\]

and

\[
\pi^c = \frac{Ak(g + B(1 + \theta p))}{1 + Ak^2}
\]

As long as the risk premium is independent of the fundamentals of the economy, the incentive scheme of the policymaker does not change substantially, i.e. a substantial
inflationary bias persists as long as there is a stock of national currency to use as a base for the inflation tax.

IV Currency risk associated to changes in fundamentals.

In practice there is a relationship between the currency premium and the fundamentals of the economy. In particular, there is a large industry in charge of computing the probability of default associated with each scenario, that probability of default is traduced in risk evaluation that mirrors on the risk premium. The simple model built here does not allow for defaults, or risk assessments. Instead we are going to assume the existence of a relationships going from the fundamentals of the economy to the currency risk. In particular, we will assume that the currency risk is related to the variance of inflation. This assumption is standard in the finance and insurance literature, and relates to the fact that the riskier the project the bigger the risk premium that a risk averse individual would ask to take it on. Additionally we assume that the variability of inflation is associated to the level of inflation, a stylized fact that can be found repeatedly in the literature.\(^1\) The expression chosen is

\[
(11.) \quad p = \phi(\sigma^2) = \sigma^2 = b\pi^e
\]

Assume furthermore that

\[
(12.) \quad k = B\theta b ,
\]

to avoid optimal inflation to become negative in equilibrium.

Repeating the calculations made in previous sections, it is easy to show that

\[
(13.) \quad \pi^N = A(g + B)(B\theta + k) \quad \text{and}
\]

\[
(14.) \quad \pi^C = 0
\]

When the risk premium associated to holding domestic currency denominated debt is increasing on the variability of inflation, and this depends positively on the levels of inflation, commitment inflation drops to zero. Notice that the lack of commitment forces expected inflation to be high, and therefore induces a high real interest rate.

V Monetary financing with bad reputation.

The issue raised by the previous paragraphs is one of reputation and the cost of maintaining a monetary instrument. According to what we saw, the optimal taxation argument, namely, it is always good to generate some inflation to reduce the cost of using other taxing instruments, vanishes when we take into account the relationship between risk premia and inflation. If that relationship is taken into account, the optimal inflation rate goes down to zero. Once this issue has been settled, the next question is whether a country can achieve zero inflation by itself, and more importantly, whether that country can convince the private sector that inflation stabilization has come to stay. If we look at the data, one can observe that a couple of implications of this model are present in the case of chronic inflation countries:

a) The interest rates on nominal currency denominated bonds are extremely high, even while this countries were able to reach reasonable inflation rates, implying that the risk premia associated with this kind of instruments was really high.

b) The debt portfolio of CICs has a strong bias towards foreign currency denominated bonds, mainly dollar denominated bonds. Uruguay, with a fully dollarized portfolio is a benchmark of this kind of behavior, but even in countries which have shown a strong reluctance to allow
dollarization of their economies, like Brazil, the use of dollar indexation has became very strong.²

c) Lastly, there is a strong relationship between inflation and inflation volatility in CICs. If we look at table ... we see that all inflation series present conditional heteroskedasticity. Even though the link between risk premia and inflation volatility has not been demonstrated in this paper, there is a strong link in the data between these two variables that has been widely documented.

Then, there is the strong presumption that stabilization might arise, but that the cost of indebtedness would remain high. Off course, one can pose the argument that reputation might be built in the sense of Kreps and Wilson (1982) and Fudember and Levine (1989), the perception one gets from Chronic inflation countries is that the process can be rather slow. Additionally, one can think that there might be an additional cost of maintaining a monetary policy when there is a positive relationship between devaluation risk and country risk like in Powell (2000). This link might come from several reasons. First of all, as we said earlier, in CICs there is a tendency to resort to dollar denominated public debt in some cases as a last resource to get financing, in others as a cost reducing strategy. The dollarization of public debt reduces substantially the incentives to generate surprise inflation, as we shown in section.... A devaluation would increase the cost of servicing public debt, and, depending on the size of public debt it might end up increasing the fiscal problem rather than solving it.

² Barro (1997), Missale (1997) and Goldfajn (1997) highlight the role of indexed bonds to provide the kind of insurance the private sector needs against inflation volatility. The introduction of a indexed bond would not change the results of the paper.
Notice that even the last argument might underscore the impact of maintaining a currency in the cost of financing because we are not considering the impact of devaluation risk on country risk. Devaluations might cause the realization of a potential liability, mainly in the financial sector. One of the main consequences of dollarization is that the exchange rate risk is present in the payment system, and shows up as a risk for the financial system. If banks have a perfect currency matching, the mismatch appears on the private sector. Then, in a dollarized economy, the financial system is either faced with currency risk or credit risk.
References


