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by

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Abstract

There are several real world examples of local governments that, faced with budget problems, circulate a fiat token in parallel to the official currency. We present a simple model to analyze the workings of equilibria where the parallel currency is valued in equilibrium and discuss its consequence for real allocations in terms of a simple equivalent fiscal policy.

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1 Introduction

There are several real world cases of local governments or administrations resorting to the printing of some paper voucher, be it an IOU or a scrip, when faced with budget problems. It happened in 2001 in Argentina, where the federal government in need of funds resorted to the issuance of small denomination liabilities (the *lecop*) redeemable for tax payments, see de la Torre, Levy-Yeyati, and Schmukler (2003). The same thing happened in the province of Buenos Aires, where financing needs in excess of local revenues and federal transfers led to the launch of the province's own small denomination paper, the *patacon*. Overall such "parallel-currencies", scrip that circulate next to the official currency, reached more than 2,600 millions of Argentine pesos or about 26 percent of total pesos in circulation by the end of December 2001, and had almost doubled by the end of March 2002 (Table 7 in de la Torre, Levy-Yeyati, and Schmukler (2003)).

Such a policy has a past, a present and a future. Massachusetts paid its citizens with "tax anticipation notes" instead of cash in the 1690s. These were swapped for cash once the anticipated tax had been collected, see Sylla (2010). California used scrip in 2009: the recession had hit revenues and legislators could not agree on a revised budget. The state began to pay benefits, tax rebates and other bills in "registered warrants" rather than dollars. In all, it issued 450,000 IOUs with a value of \$2.6 billion (Steinhauer (2009)). During the 2015 Greek debt crisis the possibility to issue some kind of government scrip for funding budget deficits was discussed (Goodhart and Tsocomos (2010)). After the 2018 Italian election the program of the coalition government envisages the printing of a quasi-currency (the so called "mini-Bot") to reimburse government contractors of their outstanding credits.

In spite of the recurrent appearance of such policy experiments there is no simple monetary model to analyse the real consequences of such policies. We see two desirable features that such a monetary model should have: first, the model must rationalize the coexistence of both the official and the parallel currency as an equilibrium phenomenon. Second, it must illustrate the consequences consequences of the policy in terms of real allocations. While the first objective has been successfully achieved by several monetary models, such as Kiyotaki and Wright (1993); Aiyagari and Wallace (1992), this paper complements such analyses by presenting a simple model that provides an analytic illustration of the second feature, namely its effects in terms of real allocations, which will allow us to describe the monetary policy in terms of an equivalent fiscal policy.

We use an overlapping generation model (OLG) to describe a monetary economy, where trade is made possible by the use of a fiat currency, and consider the policy of a government who resorts to printing fiat tokens to be circulated next to the official currency. To make sense of the phenomenon in a way that is not completely trivial, such as the case in which the new fiat currency has no value,[1] we will focus on an economy with segmentation, namely featuring 2 types of agents, and with limited fiscal sovereignty in the sense that the government is limited in its ability to levy new taxes. After setting up the pure-currency environment using an OLG model, Section 2.1 analyzes the possibility of monetary equilibria in which the parallel currency, which is printed and transferred to a subgroup of the population, is valued in equilibrium. Section 3 extends this basic setup to the case in which the government supplements the issuance of the parallel currency with a future commitment to accept such tokens for future tax payments. The main result is that, in each of these cases, monetary injections amount to a real transfer from the whole population to the fraction of agents receiving the transfer. It is thus completely equivalent to a fiscal policy, implemented through ordinary taxation, to benefit the recipient group.

Related literature. The main ingredients of our model are taken from some classic models in the monetary economics literature. The pure currency economy we consider goes back to the OLG model of Samuelson (1958), the simplest environment to have a pure currency valued in equilibrium. Moreover we assume the economy is segmented, as in Alvarez, Lucas, and Weber (2001), by positing that only a subset of the population, e.g. government creditors

[1] See Capone (2016) for a case study of the failed attempt to circulate a local currency by the municipality of Naples in 2014.

or employee, benefits from the injections of the parallel currency. Our model also discusses the possibility that, in order to ensure the parallel currency will be valued in equilibrium, the government may commit to accepting it in future for tax payments. This assumption echoes the ideas in Starr (1974); Aiyagari and Wallace (1997); Li and Wright (1998) about the role of a large agent who commits to stand on the other side of monetary transactions.

2 Setup

To begin consider an OLG economy where each generation lives for 2 periods (aka Samuelson '58) with constant population (unit mass of young). The utility function of cohort t is

$$U_t = -\ell_t + \beta u(c_{t+1}) \tag{1}$$

i.e. consumption occurs only when old. When young produce $y_t = \ell_t$ (disutility $-\ell_t$).

Endowment economy. To keep things even simpler we begin with an "endowment economy" version. In each period the young receive an endowment y but cannot work ($\ell = 0$), the old receive nothing. We relax this assumption in Section 2.3.

Trade and means of payments. In each period the old (who want to consume but have no goods) want to buy the goods from the young. We assume anonymity (i.e. agents have no means to keep track of trades), this gives fiat money a "memory" role, which makes it accepted in exchanges because of its services in future exchanges. The economy has constant (for simplicity) outside money M. Moreover a fraction $\lambda \in (0, 1)$ of the old receive a transfer in "Patacon", a piece of paper by the local government (intrinsically useless, i.e. a claim to nothing) in each period. Assume that each period the government prints

$$\Delta N_{t+1} \equiv N_{t+1} - N_t = \theta_{t+1} N_t \tag{2}$$

new Patacones, so the stock of Patacones grows at the (net) rate θ_t.

Agents and prices. There are 2 types of old agents in the economy: agents who receives the transfer and the others. Let P_t be the euro price of the consumption good and q_t be the euro price of Patacones, i.e. the number of euros M needed to buy one Patacon.

The budget constraint for a young agent who will receive the transfer when old (indexed by superscript T) is

$$c_{t+1}^T = \frac{M + N_t q_{t+1} + X_{t+1}}{P_{t+1}} \tag{3}$$

where X_{t+1} is the period's transfer per recipient, expressed in euros:

$$X_{t+1} \equiv \frac{\Delta N_{t+1} q_{t+1}}{\lambda} \quad . \tag{4}$$

The budget for the agent who does not get the transfer is

$$c_{t+1}^N = \frac{M + N_t q_{t+1}}{P_{t+1}} \tag{5}$$

Feasibility and stationarity give

$$y = (1 - \lambda) c^N + \lambda c^T \tag{6}$$

Each period trading between old and young occurs in a centralized market where both currencies are used by the old to buy goods y from the young, so that market clearing requires

$$y P_t = M + N_t q_t \tag{7}$$

2.1 Stationary Equilibria with and without Patacon

This section adopts a standard notion of monetary equilibrium and analyzes two classes of equilibria: one where Patacon are not valued and another in which they are. For the latter, we derive a fiscal monetary equivalence that shows how the transfert of Patacones to a subset of the population is equivalent to the introduction of a fiscal transfer that taxes the whole population and transfers resources to this group.

Stationary Equilibrium: a sequence of nominal money supplies $\{M, N_t\}$, prices $\{P_t, q_t\}$ and time-invariant real allocations $\{c_t^i, \ell_t^i\}$, for all $i = \{T, N\}$ and all $t = 1, 2, 3, ...$, such that markets clear at each point and consumers optimize their production / savings decisions.

Indeterminacy: the quantity equation is not enough to pin down prices. Notice that market clearing implies

$$y = \frac{M + N_t q_t}{P_t} \tag{8}$$

Equation (8) is reminiscent of the exchange rate indeterminacy problem. Both P_t and q_t are endogenous and there is one equation. For a given M and $\{N_t\}$ sequence there is a continuum of $\{P_t, q_t\} \in \mathbb{R}^{++}$ pairs that satisfy the quantity equation. To solve this indeterminacy we now analyze the individual agent's euler equation that concern the usage of both euros and Patacones.

Euler equations. A young agent exchanges output y for euros M and patacones N. Using the preferences and the equation (7) we have the first order conditions (for M and N respectively)

$$-1\,\mathcal{I}_e + \beta u'(c^i)\frac{P_t}{P_{t+1}} \geq 0 \quad \text{and} \quad -1\,\mathcal{I}_e + \beta u'(c^i)\frac{P_t}{P_{t+1}}\frac{q_{t+1}}{q_t} \geq 0 \tag{9}$$

where the indicator function $\mathcal{I}_e = 0$ in the endowment economy. These equations imply that the indifference condition for a seller to accept both currencies is that they carry an identical expected return, i.e. that

$$1 = \frac{q_{t+1}}{q_t} \tag{10}$$

which means that the price of patacones must be stationary, $q_t = q$.[2]

Equilibrium with worthless Patacones. One possibility is $q_t = 0$ (Patacones are worth nothing), so that $P_t = P = M/y$. There are indeed a few interesting instances of local governments printing a parallel currency without committing to accepting them in future for tax compliance in which the parallel currency ended up having no value (see E.g. the case of the Napo in Naples 2014).

2.2 Equilibria with worthy Patacones.

Another possible class of equilibria has Patacones that are valued in equilibrium at a constant exchange rate vs the euro, so $N_t q = \tilde{N}_t > 0$. As we saw the value of q is not pinned down by the simple model we have thus far. This implies that $P_t = \frac{M+\tilde{N}_t}{y}$. Notice that any $\tilde{N}_t \in \mathbb{R}^+$ is admissible.

A fiscal-monetary equivalence: For concreteness, let's consider an example where the stock of Patacon has value $\tilde{N}_t$. Let τ denote the value of the Patacon transfer to the recipients,

[2]Formally, consider the problem for the agent who does not get the transfer (a problem with identical margins is faced by the other agent since the only difference is due to a lump sum transfer)

$$\max_{\ell, M, N_t} -\ell + \beta u\left(\frac{M + N_t q_{t+1}}{P_{t+1}}\right) + \lambda_t(P_t \ell_t - M - N_t q_t)$$

where λ_t is a lagrange multiplier. The first order conditions yield

$$\lambda_t = 1/P_t \quad , \quad \beta \frac{u'(c_{t+1})}{P_{t+1}} = \lambda_t \quad , \quad \beta \frac{u'(c_{t+1})\, q_{t+1}}{P_{t+1}} = \lambda_t q_t$$

which yields equation (10).

as a fraction of their endowment y:

$$\tau_t \equiv \frac{\lambda X_t}{y\, P_t} \tag{11}$$

which after simple algebra can be rewritten as

$$\tau_t = \left(\frac{\tilde{N}_t}{M + \tilde{N}_t}\right) \frac{\theta_t}{(1+\theta_t)} \tag{12}$$

which can of course amount to a constant transfer $\tau_t = \tau$ by an appropriate choice of θ_t.

Assuming a stationary equilibrium, equation (3) and equation (5) give the following consumption allocations[3]

$$c^N = y(1-\tau) \quad \text{and} \quad c^T = y\left(1 + \tau\frac{1-\lambda}{\lambda}\right) \quad . \tag{13}$$

This result illustrates the equivalence between a fiscal and a monetary policy (supporting identical allocations). In this equilibrium the injection of Patacon amounts to a real transfer of size $(1-\lambda)\tau y$ from the non-recipient agents to those who receive the transfer, a policy that might alternatively be implemented through direct fiscal transfers between these groups. This is because the injections of Patacon, that arrives only to a fraction of the population, ends up raising the price level $P_t = y(M + \tilde{N}_t)$. This implies that the real value of money holdings from the previous period falls, eroding the purchasing power of those who do not get the transfer. Notice also that the model has only one parameter determining the transfer size, namely τ, implemented by a proper choice of the sequence $\{\theta_t\}$.

2.3 Production economy

Suppose now that agents' labor supply is endogenous. The agents know they can work while young exchanging the output of their labor for money, to be used in the future. Work in period t gives units of output exchanged for $M + \tilde{N}_t$ euros to spend tomorrow, the exchange

[3]To see this rewrite equation (5) as $c_t^N = \frac{M + N_t q \frac{N_{t-1}}{N_t}}{P_t}$ which gives $c_t^N = y\left(1 - \frac{\theta_t}{1+\theta_t}\frac{\tilde{N}_t}{M+\tilde{N}_t}\right)$.

equation gives $\ell_t P_t = M + \tilde{N}_t$ where we used the production function $y_t = \ell_t$. Notice that the future real value of the money is $\frac{M+\tilde{N}_t}{P_{t+1}}$, and we can thus write $c^N_{t+1} = \frac{\ell P_t}{P_{t+1}}$ where it is immediate to see that the depreciation rate of money holdings is

$$\frac{P_t}{P_{t+1}} = 1 - \frac{\tilde{N}_{t+1}}{M + \tilde{N}_{t+1}} \frac{\theta_{t+1}}{(1+\theta_{t+1})} = 1 - \tau$$

The first order condition for labor supply gives $-1 + \beta u'(c)(1-\tau) = 0$ which implies

$$u'(\hat{c}) = \frac{1}{\beta(1-\tau)}$$

It is immediate that the labor supply is decreasing in the level of the transfer, τ. A higher transfer level, implemented through a higher injection rate of Patacones (θ), lowers the expected return on money holdings (raises inflation) and thus creates a disincentive to work through an adverse substitution effect.

3 Government commitment to accept Patacones for tax payment

This case is of interest because in several historic episodes the government that issues the parallel currency also commits to accepting it in future as a tax payment, in a direct attempt to create a demand for it. This assumption obviously connects with theories of money that attribute a central role to the presence of the state, as in Knapp (1924), or equivalently a money issuer that has a large size as in Aiyagari and Wallace (1997); Li and Wright (1998). Indeed, a reasonable criticism of the monetary equilibrium described in Section 2.2 is that we do not have an explanation for why agents might be induced to believe that Patacon will be valued in future upon their introduction. As mentioned, there are historic examples of parallel currency whose introduction turned out to be a complete failure, in the sense that agents did not accept them in the exchange. In this respect, the issuing government commitment to accept Patacon for e.g. tax payments in future provides a convenient, and in many cases realistic assumption, that helps supporting the equilibria with worthy Patacon. For simplicity we continue the discussion considering the endowment economy.

Just like the previous economy, we continue to assume the government levies an amount $\tau > 0$ from each citizen and transfers it to a group of size λ, who receives the transfer $X_{t+1}/P = \tau y/\lambda$ as from equation (11). The novelty is that the financing of the transfer, which previously occurred entirely through money printing, not occurs through both an income tax as well as money transfers. A key assumption is that the government commits to accepting both Patacones and euros *at par* for tax receipts, paid by the old before consuming.

The government budget constraint is (in euros)

$$\lambda X_t = T_t + \theta N_{t-1} q_t \tag{14}$$

where $T_t > 0$ is the euro tax paid by each citizen (the case where $T_t = 0$ was analysed in the previous section) and $\theta N_{t-1} q_t$ is the euro value of the Patacon transfer.

We assume that $N_{t-1} < T_t$ i.e. that the stock of Patacones brought from the previous period is smaller than the total tax due. By an immediate arbitrage relation this implies that $q_t = 1$, and that the total tax is paid with both euros T^M and Patacones $T_t^N = N_{t-1}$, i.e. that $T_t = T_t^M + N_{t-1}$.[4]

Dynamics of money supply. In period t the old reach the market for good y with euros H_t given by

$$H_t \equiv M - T_t^M + (N_{t-1} - T_t^N) + \lambda X_t = M + N_t \tag{15}$$

[4]As announced the euro tax can be paid with either euro banknotes or patacones, which the government accepts at par.

Which is the money they earned in the previous period $M + N_{t-1}$ (evaluated at period t euros), and the transfer λX_t net of taxation. Using that $q_t = 1$ and $T_t^N = N_{t-1}$ gives

$$H_t \equiv M - T_t^M + \lambda X_t = M + N_t \tag{16}$$

This money is exchanged for good y so that

$$y\ P_t = M + N_t \tag{17}$$

Notice that given $q_t = 1$ an increase in the stock of the money supply implies a proportional change of the price level P_t.

Consumption. Give the targeted transfer τ discussed at the beginning of the section, the consumption schedules for the two types are exactly as in equation (13) analyzed above. The only interesting question is how resources are levied from the population to pay for the transfer $\tau(1-\lambda)/\lambda$ to each transfer-recipient.

Equation (11) immediately implies that

$$\frac{\lambda X_t}{P_t} = \tau y = \frac{T_t + \theta_t N_{t-1}}{P_t} \tag{18}$$

Notice that if $\theta = 0$, i.e. the stock of Patacon remains constant after they are introduced, then the injection of Patacon is fiscally irrelevant: it does not matter whether agents pay their taxes using euros (T^M) or euros and Patacones ($T^M + T^N$). The economy with Patacones has a higher price level (through the quantity theory equation) and identical tax incidence and real allocations than an economy without Patacones.

When $\theta > 0$ the fiscal transfer is financed both through regular taxes (T_t/P_t) as well as through an inflation tax $(\theta_t N_{t-1}/P_t)$.

4 Concluding remarks

This note established an equivalence between the issuance of a parallel currency, allocated to a group of the population, and a fiscal transfer that assigns income to that same group. There are several historic episodes of countries that resort to printing a token, or issuing a scrip, in times of fiscal difficulties. This might suggest that in such instances politicians find it easier to levy resources using the printing press than by enacting ordinary fiscal policy. We think the analysis of the political conditions behind such policies are worth further investigations.

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