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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. A well known case is the Argentinian "Patacon", printed by the province of Buenos Aires during the crisis of 2001. We present a simple model to analyze the workings of monetary equilibria where the parallel currency is valued in equilibrium and discuss its consequence for real allocations in terms of an equivalent fiscal policy. We briefly discuss different model specifications and their fit to alternative historic experiences.



JEL Classification: E3, E5

Keywords: Parallelcurrency, dual currency, monetary economy, pure currency, scrip, Chartalism



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# The fiscal arithmetic of a dual currency regime *

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April 20, 2020

**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. A well known case is the Argentinian "Patacon", printed by the province of Buenos Aires during the crisis of 2001. We present a simple model to analyze the workings of monetary equilibria where the parallel currency is valued in equilibrium and discuss its consequence for real allocations in terms of an equivalent fiscal policy. We briefly discuss different model specifications and their fit to alternative historic experiences.

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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", scrips 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 scrips 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 winning coalition envisaged the printing of a new government liability (the so called "mini-Bot") to reimburse government contractors of their outstanding credits.[1]

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

[1] The Italian government eventually did not implement the proposal.

illustrate the 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, 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. Section 4 relates the theory to some recent historic examples.

**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); Alvarez and Lippi (2014), by positing that only a subset of the population, e.g. government creditors 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 "scrip", a piece of paper issued by a local agent (intrinsically useless, i.e. a claim to nothing) in each period. Assume that each period the stock of scrip grows at the (net) rate $\theta_t$, so that

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

**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 dollar price of the consumption good and $q_t$ be the dollar price of the scrip, i.e. the number of dollars needed to buy one scrip.

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 dollars:

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

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 Scrips

This section adopts a standard notion of monetary equilibrium and analyzes two classes of equilibria: one where the scrips are not valued and another in which they are. For the latter, we derive a fiscal monetary equivalence that shows how the transfer of scripts to a subset of the population is equivalent to the introduction of a fiscal transfer that taxes the whole population and channels 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 agent's Euler equation for dollars and scrips.

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

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

where $\mathcal{I}_p$ is an indicator function that equals one in the production economy, zero otherwise. 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 the scrip must be stationary, $q_t = q$.[2]

**Equilibrium with worthless Scrips.** One possibility is $q_t = 0$ (the scrip is worth nothing), so that $P_t = P = M/y$. We briefly discuss historic applications of this result in Section 4.

## 2.2 Equilibrium with worthy Scrips.

Another possible equilibrium has Scrips that are valued in equilibrium at a constant exchange rate vs the dollar, 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 scrips has value $\tilde{N}_t$. Let $\tau$ denote the value of the scrip transfer to the recipients, as a fraction of their endowment $y$:

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

[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 $\lambda_t$ 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).

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 $\theta_t$.

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 scrips 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 injection of scrips, that reaches only a fraction of the population, increases 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 $\tau$, 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 $M + \tilde{N}_t$ dollars to spend tomorrow, the exchange 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 $c^N_{t+1} = \frac{\ell_t P_t}{P_{t+1}}$ where it is

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

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, $\tau$. A higher transfer level, implemented through a higher injection rate of scrips ($\theta$), 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 Scripts 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 scrips 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 scrip for e.g. tax payments in future provides a convenient, and in many cases realistic assumption, that helps supporting the equilibria with worthy scrips. 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 $\lambda$, who receives the transfer $X_{t+1}/P = \tau y/\lambda$ as from equation (11). The novelty is that in this economy the financing of the transfer occurs through both an income tax and a money transfer, while in the economy of Section 2.2 the financing was entirely done by printing money. A key assumption is that the government commits to accepting both scrips and dollars *at par* for tax receipts, paid by the old before consuming.

The government budget constraint is (in dollars)

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

where $T_t > 0$ is the dollar tax paid by each citizen (Section 2.2 assumed $T_t = 0$) and $\theta N_{t-1} q_t$ is the dollar value of the scrip transfer.

We assume that $N_{t-1} < T_t$ i.e. that the stock of scrips 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 dollars $T^M$ and scrips $T_t^N = N_{t-1}$, 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 dollars $H_t$ given by

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

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

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

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

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 $\tau$ 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 scripts is constant after they are introduced, then the injection of Scrips is fiscally irrelevant: it does not matter whether agents pay their taxes using dollars ($T^M$) or dollars and scrips ($T^M + T^N$). The economy with scrips has a higher price level (through the quantity theory equation) and identical tax incidence and real allocations than an economy without scrips.

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 Discussion

This section briefly discusses how the model specifications discussed above can be adapted to interpret some real world examples of a dual currency regime. The model in Section 2.2 does not entail the presence of a non-atomistic economic agent, such as a Government. Such a version of the model might be apt to describe the private issuance of notes during the free banking era. On a smaller scale, the model might capture the phenomenon of some local quasi-currencies, such as scripts issued by private corporations that circulate and are accepted for exchange by the traders. One such example might be that of the Canadian tire money, a coupon issued by the Canadian Tire company, which resemble real banknotes, and can be used for purchases in their store but is occasionally accepted outside of that circuit. The model clearly shows that the issuer of the scrip is able to extract resources from the population. This is a form of "seignorage revenue" that accrues to the issuer. The model is however silent on what conditions enable to private issuer to make the script "valued" in equilibrium. As customary in monetary models, the same setting also features an equilibrium in which the private script has zero value and is not used in transactions. In Italy for instance there have been a few interesting attempts of local authorities to print a parallel currency, with no commitment to accepting them in future for tax compliance, that ended up with the parallel currency having no value (see E.g. the case of the "Napo", in Naples 2014, and the attempt to introduce a local currency, the "Marso", in the province of Avezzano in 2013).[5]

A large (non-atomistic) Government features prominently in the model of Section 3. In such a model the Government commits to accepting the parallel currency as a future tax payment. A recent example of such a scenario is the case of the Argentine Patacones issued in late 2001 by the province of Buenos Aires. As explicitly mentioned in article 9 of the law that established them, Ministerio de Justicia y Derechos Humanos (2001), the patacones were supposed to be used to pay the wages of a large number of civil servants. As in the modeling setup of Section 3, article 13 of the same law specified that the patacones could be used to cancel debt and tax obligations vis a vis the Province of Buenos Aires.[6] As noted in the discussion of equation (18) the printing of Patacones implies a real transfer of resources to a particular group of the population. It is clear that the policy allows the government to

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

[6]'Artículo 13: Los tenedores de Patacones y/o Bonos de Cancelación de Obligaciones podrán aplicarlos, asu valor nominal, al pago de obligaciones con la Provincia, incluyendo impuestos, tasas y contribuciones y sus respectivos accesorios. "

levy resources from the population, through exactly the same mechanisms that is at work when government levies seignorage by using the printing press. The only difference of our mechanism is that is affects the population asymmetrically, i.e. the government uses such revenues to compensate a sub group in the population. Our model has nothing to say about why the government prefers to achieve such a redistribution by printing a new currency rather than by using ordinary taxation.

Finally, in looking at historic experiences, there is a yet another form of scripts, sometimes dubbed "complementary currencies". This is the case for several tokens that circulate in e.g. the United Kingdom, such as the Bristol Pound, the Brixton Pound, the Lewes Pound and others, see the survey in Naqvi and Southgate (2013). A simple model for such complementary currencies is the one in Section 4 by Kiyotaki and Wright (1993). These authors construct a search-theoretic equilibrium where two types of currencies coexist. An interesting feature of that model is that in spite of the fact that the "parallel" currency is less liquid than the other (in the sense of being accepted by a smaller fraction of traders), both currencies are valued in equilibrium and hence used in the exchange, in spite of the fact that the more liquid one yields a higher welfare to the holder of the currency. One can use this simple framework to establish that an agent issuing the parallel currency and distributing it in exchange for the more "liquid" currency realizes a net welfare gain, as in the models we saw above, albeit through a non-inflationary mechanism.[7] It is also possible to prove that the equilibria without the complementary currency Pareto dominate equilibria with two currencies. It is clear that the motives for creating such complementary currency transcend the simple structure of our model. Building models where such motives are present is an interesting step for future research.

[7] The derivation of these results is straightforward from the results in section 4 of Kiyotaki and Wright (1993) under the assumption of instantaneous production $\alpha \to \infty$. A short note is available from the author upon request.

# 5 Concluding remarks

There are several historic episodes of countries that resort to printing a token, or issuing a scrip, in times of fiscal difficulties. We analyze a simple monetary a model in which the injection of the parallel currency is given to a selected group in the population. Using a simple segmented markets model we 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. 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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