The Tax-Foundation Theory of Fiat Money

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Abstract

A government can promote the use of an object as the general medium of exchange by accepting it in tax payments. This is shown for the first time in a dynamic model. I explore the similarities and differences between this mechanism and convertibility. The government can often keep its favorite money in circulation even while increasing its quantity and thus decreasing its value. This opens the door for an inflationary policy. Most successful fiat moneys have been acceptable for tax payments, typically due to legal tender laws. Numerous historical failures of fiat moneys are also consistent with the theory.

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"In practice credible sovereign power—specifically, the ability to enforce the legal tender status of fiat money—is necessary to create the expectations that support a viable fiat money. (Recall that the defeat of the Confederacy rendered Confederate fiat money worthless). ... The reconciliation of theory with 'facts' about fiat money remains a central problem in monetary economics."

Herschel Grossman (1991)

1 Introduction

The circulation of inconvertible, intrinsically useless money is a fundamental puzzle in monetary theory. Standard models, such as the random matching model and the overlapping generations model, attribute it to self-fulfilling expectations. In these models there is always an equilibrium in which such money does not circulate because nobody believes that it will. Such an equilibrium must exist in any model that takes the micro-foundations of such money seriously. The literature has shown that this non-monetary equilibrium can be eliminated only by introducing an external entity, i.e., a government. The government can simply force agents to accept fiat money in trade[1]. Alternatively, if the government itself accepts the money in trade, this can induce agents to do so too[2]. However, the application of either mechanism to modern capitalistic democracies is questionable. In such countries nobody has to accept the government's favorite money in spot transactions. Although some believe that legal tender laws force money on all transactions, this is clearly not true, as central banks openly admit[3]. As for government sales, in many

[1] E.g., Lotz and Rocheteau (2002), Selgin (2003).

[2] E.g., Aiyagari and Wallace (1997), Li and Wright (1998).

[3] Legal tender laws are only about settling an obligation that had already come into existence as a result of a previous contract or a tax law. There is nothing illegal in a seller posting an announcement in his shop, saying that he would not accept the domestic legal tender. For official explanations see http://www.bankofengland.co.uk/banknotes/about/faqs.htm, http://www.federalreserve.gov/generalinfo/faq/faqcur.htm#2 . See Goldberg (2006) for a detailed discussion.

countries this amounts to nothing more than sale of postal stamps.

This paper explores another mechanism of government intervention, which appears in every modern legal tender law. The government chooses which objects to accept in tax payments, and this choice can affect the value of these objects and their potential to circulate as media of exchange. To explore this mechanism I explicitly insert it in a monetary search model. The mechanism is shown to be powerful, as long as the government is expected not only to survive but also to maintain an effective tax-collection mechanism. In contrast to convertibility, the government's ability to sustain the money's circulation may be unharmed by excessive money printing.

This theory, succinctly named "the tax-foundation theory" by Ellis (1934, p. 11), had been practiced in China for centuries, reinvented in Massachusetts in 1690, and was briefly discussed by Smith (1776) and Lerner (1947)[4]. It is modeled in Starr (1974) in a Walrasian model with a cash-in-advance constraint on consumption, and again in Starr (2003) in a trading post model. In both models, which are static, everyone is taxed with probability one. The current paper is the first to analyze the tax-foundation theory in a dynamic model. This allows the model to take into account expectations about the future viability of the government. This is important when accounting for the correlation between a political change and a monetary change. Further, I show that the theory does not require all agents to be taxpayers at every period. Thus, it is robust to some level of tax deferment, tax evasion, and tax exemption. The need to reconcile the tax-foundation theory with random matching models is clearly emphasized by Charles Goodhart's critique that economists are attached to such "nicely constructed models, whatever the facts may be" even though the tax-foundation theory "does far better in explaining and predicting historical reality" (Goodhart [1998], p. 408-9). The current paper shows that Goodhart's preferred theory actually can be well formalized in a variant of the random matching model.

[4] On China, see von Glahn (1996). On Massachusetts, see Goldberg (2007). Wray (1998) and Forstater (2006) survey the history of economic thought on this theory.

The mechanism explored here should not be confused with similar ones. It is just one ingredient of Knapp's (1905 [1924]) "state / chartal theory of money," according to which the government must support the money in many additional ways[5]. The tax-backing theory (Wallace [1981], Sargent [1982], Smith [1985]) and the fiscal theory of the price level focus on the determination of the price level *given* that the money does circulate. In contrast, the issue here is whether any monetary equilibrium is realized *at all*, and the key determinant of that is not the tax rate or deficits, but which object is used to pay taxes, and what is the penalty for paying taxes with other objects. To emphasize the different focus of the tax-foundation theory, in my model public deficit can never exist. As Cowen and Kroszner (1994, p. 148-9) claim, the similarity to the legal restrictions theory is superficial. Indeed, both theories claim that government-issued fiat money may be valued only because of government regulation. However, the legal restrictions theory claims that only the government is strong enough to suppress market-created money. The tax-foundation theory has been sometimes interpreted as implying that markets are too weak to create their own fiat money.

The paper is organized as follows. Section 2 presents the basic model with exogenous prices, a unit upper bound on money holdings, and a fixed money supply. Section 3 introduces a competing outside money or inside money. Section 4 allows multiple money holdings. Section 5 features endogenous prices and an increasing money supply. Section 6 shows that government-issued fiat moneys are almost always receivable for taxes in reality, and that the model can account for important historical episodes. Section 7 concludes.

[5] These include: accepting the money for any other payments such as fines, fees, payments for government-produced goods and services, and payments of banks to the central bank; using the money in its purchases; declaring it legal tender in private contractual debts; and fixing the money's exchange rate with the previous domestic money.

2 The Basic Model

The main goal of this paper is to model the tax-foundation theory in a monetary search model. Such models typically exhibit complete randomness of all meetings between all agents, so they are also known as random matching models. However, a salient feature of real-life taxation is some lack of randomness. People know when they are going to be taxed, and they usually know the terms: How much, where, how, and in what medium of payment. People have enough time to prepare for a tax payment. Some taxes can be completely, and legally, avoided by avoiding a certain activity. It is therefore important to use a model in which taxation is not completely random[6]. As for the trade meetings, I maintain the same randomness as in random matching models. I do this for the sake of comparison with random matching models of competing mechanisms. In particular, the model is designed to be as close as possible to Li and Wright (1998), who model sales of government goods for fiat money as a way to support that money.

2.1 Environment

Time is discrete. A continuum $[0, 1]$ of infinitely-lived agents are randomly matched in pairs according to a Poisson arrival rate α. A fraction $\gamma \in [0, 1)$ of them are potential government buyers, and the rest are private agents. Each private agent derives utility $U > 0$ from the consumption of one indivisible unit of some goods. He can produce only one type of good and he does not consume it. Production of one unit of any (perishable) good is instantaneous and involves disutility $C \in (0, U)$.[7] Production is independent of previous consumption, but agents can produce if and only if they do not hold money[8]. The probability that any private agent consumes the good of his trading partner is $x > 0$, and the conditional probability

[6] For a model of the tax-foundation mechanism with completely random matching, see Goldberg (2002).

[7] While commodity money is ruled out here by assumption of perishability, I do allow it in Goldberg (2002).

[8] This assumption differs from Li and Wright (1998). It allows agents who were just taxed to resume market activities, while keeping one unit of money as an upper bound on their holdings.

that the converse holds too is $y \geq 0$. The discount rate is $r > 0$.

For now, the only durable object is fiat money called a dollar bill, which has a storage cost $c > 0$ and a fixed supply $M_\$ \in [0, \gamma]$.[9] A fraction m_p of private agents are endowed with one dollar each and are called *private buyers*. The other private agents hold nothing and are called *sellers*. Variables that relate to sellers and real goods have a subscript 0.

The potential government buyers participate in the matching process described above. They consume all goods, cannot produce anything, and cannot store any real good. These assumptions, starkly different from Aiyagari and Wallace (1997) and Li and Wright (1998), emphasize that the tax-foundation mechanism, unlike convertibility, can work even for a government which is completely parasitic and cannot credibly promise convertibility into real goods. Among the potential government buyers, I focus on the fraction m_g of them who hold money (one dollar each). These are called *government buyers*. When a government buyer is randomly matched with a seller he offers his money for the seller's good. He *does not* force the seller to trade. If the money is accepted, then he consumes and becomes a potential government buyer. Being moneyless he can do nothing until he receives a new dollar, as described below.

In addition to all these randomly matched agents, there is another class of government agents, called *tax collectors*. They operate outside of the matching process described above. They are idle during trade meetings and operate right after them (similar interaction of private agents with the government after trade is already used in Shi [2005]). The tax collectors are capable of identifying agents who had just produced, say because these sellers show signs of exhaustion. The only tax law in the economy states the following. 1. Only income is taxed. 2. An agent who just sold is taxed with probability $\tau \in (0, 1)$. 3. The size of the tax payment is the entire income just earned. 4. Tax collectors cannot reject tax payments in dollar bills. 5. Tax collectors are allowed to choose whether to accept a tax payment in real

[9] As in Aiyagari and Wallace (1997), this upper bound on money simplifies the analysis because then all the money is held by the government when private agents reject it.

goods. 6. Agents whose payment is rejected face a non-monetary punishment $P > 0$.[10] After taxes are collected all the proceeds are transferred to the potential government buyers, with each buyer getting at most one dollar. Then a new period begins.

This tax law is different from totally random taxation. Agents know that only a sale will make them eligible for paying the tax. They can choose never to be exposed to the tax. They can also choose to make a sale only if it leaves them well prepared for the tax collector's visit (say, sell for dollars but avoid barter). Nevertheless, some randomness must remain for the sake of analytical tractability. If $\tau = 1$ was allowed, the only way to keep production incentive-compatible would have been to tax only a fraction of one's income. This would have necessitated an increase in the upper bound on money holdings, and would have generally precluded closed-form solutions. A good by-product of this limited randomness is that it approximates tax evasion, tax exemption, tax deferment, and the fact that income taxes are not paid after every single sale. Note that the only existing models of the tax-foundation theory already have $\tau = 1$ (Starr [1974, 2003]). Let G denote the subjective probability that private agents assign to the existence of a taxing government in the next period. Denote the expected probability of being taxed as $t \equiv \tau G$.

Section 4 of the tax law specified above is actually a legal tender law. Explicitly, it imposes an obligation only on tax collectors, and it says nothing about objects other than dollar bills. However, its silence regarding other objects means that tax collectors have full discretion whether to accept such objects or not (section 5 of that tax law). For example, in the U.S., the tax authority chooses to accept checks (to be modeled below) but generally refuses to accept real goods. It is the silence of the U.S. legal tender law regarding such objects which empowers the tax authority to make such a decision.

Finally, note that the government always has a balanced budget in the sense that taxation precedes

[10] The punishment can be thought of as beating. It is possible to model it as a fine paid in real goods produced by the offender, as in Soller-Curtis and Waller (2000).

consumption for all government buyers. With no government borrowing the controversial fiscal theory of the price level is irrelevant and the current discussion is isolated from it.

2.2 Strategies

Trade meetings allow sellers to barter in some cases and sell for money in other cases. Let Π_0 be the probability that a random seller agrees to barter. Let $\Pi_\$$ be the probability that a random seller accepts money. Let π_0 and $\pi_\$$ be the best responses of a maximizing seller who is offered a good he consumes, and a dollar, respectively. Let $s \equiv (1-\gamma)(1-m_p)$ be the proportion of sellers. Let T_0 indicate whether tax collectors accept real goods ($T_0 = 1$) or not ($T_0 = 0$). If V_0 and $V_\$$ are the value functions of sellers and private buyers respectively, then

$$rV_0 = \alpha sxy\Pi_0 \cdot \max_{\pi_0} \pi_0\{U - C + t[T_0(-C) + (1-T_0)(-P)]\} + \alpha M_\$ x \cdot \max_{\pi_\$} \pi_\$[-C + (1-t)(V_\$ - V_0)] \quad (1)$$

$$rV_\$ = -c + \alpha sx\Pi_\$(U + V_0 - V_\$) \quad (2)$$

In (1) a seller has two interesting matching possibilities. He may have double coincidence of wants with another seller. In this model the choice of barter is not trivial. Barter, which directly yields $U - C$, also makes both agents eligible for paying the income tax. With probability t a bartering agent meets a tax collector. If the tax collector agrees to accept the agent's produce then the agent produces. Otherwise, he faces the punishment P. If he meets any buyer (public or private), he needs to choose whether to accept a dollar. If he does, then he produces and gets \$1. Again, this makes him eligible for taxation. With probability t he is taxed of all his money so he remains a seller. With probability $1 - t$ he is not taxed so he becomes a buyer. Note that $V_0 \geq 0$, no matter how large P is. The reason is that agents have the capability to choose not to be exposed to the punishment (i.e., choosing $\pi_0 = 0$).

In (2) a buyer pays the storage cost of money and he can buy a good if the seller he meets accepts money. Following Li and Wright (1998), αx is normalized to 1. Assume that agents want to trade if and only if the trade would strictly increase their lifetime utility.

2.3 Equilibrium

The analysis is restricted to symmetric, pure strategy, stationary, *non-autarkic* equilibria.

Definition 1. A pure monetary equilibrium is an equilibrium in which all sellers accept fiat money but do not barter.

Definition 2. A monetary equilibrium is an equilibrium in which all sellers accept fiat money and barter.

Definition 3. A non-monetary equilibrium is an equilibrium in which all sellers barter but reject fiat money.

At the heart of the model stand two decisions. First, the tax collectors decide which objects are to be received in tax payments in addition to dollar bills. Second, the legislature determines the punishment for those whose tax payment has been rejected.

Definition 4. An object i, $i \in \{0, \$\}$, is *tax-receivable* iff $T_i = 1$.

It has already been implicitly assumed that $T_{\$} = 1$.

It is easy to discourage barter (and production in general), by simply setting a high enough probability of taxation. The point of this paper, however, is not about such a mechanism but about discrimination regarding which objects are tax-receivable. The focus is not on the probability of payment but on the medium of payment. Assumption 1 below makes sure that without such discrimination, barter—and therefore the non-monetary equilibrium—do exist.

Assumption 1. $t < U/C - 1$.

The first result is that if all objects are tax-receivable, money may not circulate at all.

Proposition 1. If all objects are tax-receivable, then: (i) the non-monetary equilibrium always exists. (ii) the monetary equilibrium exists only for some parameter values. (iii) there is no pure monetary equilibrium.

Proof. (i) Set $T_0 = \Pi_0 = 1$ and $\Pi_\$ = 0$. Clearly, $\pi_\$ = 0$, while Assumption 1 implies $\pi_0 = 1$. With barter and total rejection of fiat money, we have the non-monetary equilibrium. (ii) Set $T_0 = \Pi_0 = \Pi_\$ = 1$. Then $-C+(1-t)(V_\$-V_0) > 0$ (which implies $\pi_\$ = 1$) iff $c < c_\exists$, where $c_\exists \equiv s(1-y)U+[sy(1+t)-\frac{r+s}{1-t}]C$, and $s = 1-\gamma-M_\$(1-t)$. (iii) Assumption 1 always implies $\pi_0 = 1$. □

As usual, fiat money's circulation depends on both its intrinsic properties and agents' beliefs.

2.4 Policy

The government may be able to affect existence of equilibria by discriminating between various objects. Specifically, the government can make the dollar bill the only tax-receivable object.

Theorem 1. The government can guarantee the *existence* and *uniqueness* of the pure monetary equilibrium iff $t > 0$ and the money's storage cost is small enough.

Proof. Set $T_0 = 0$ and $P = (U-C)/t$. This implies $\pi_0 = 0$ so there is no barter. This rules out the non-monetary and monetary equilibria for all parameter values. Setting $\Pi_\$ = 1$ implies that $\pi_\$ = 1$ iff $c < c_u$, where $c_u \equiv sU - \frac{r+s}{1-t}C$. □

Without the policy, money may circulate only if $c < c_\exists$. With policy, money circulates for sure iff $c < c_u$. It is always the case that $c_\exists < c_u$, which means that in some cases policy enables money to circulate when it would not circulate otherwise. Looking at P in the proof, it is clear that the lower the probability of meeting tax collectors in the future, the higher the minimal punishment needs to be[11].

[11] I vary only the punishment and keep the tax rate fixed, since tax rates today are usually determined by the fiscal needs of the government, rather than by the need to support monetary equilibria. It is the insistence that these taxes be paid in fiat money, and the associated punishment, that can serve monetary equilibria as a positive externality. In colonial America

It is important to compare the tax-foundation mechanism to convertibility. The latter is a commitment of the issuer to convert paper money into gold or any other good or service. With the tax-foundation mechanism the government does not give anything useful for paper money, but it does give something harmful if one does not have paper money when it is time to pay taxes. One might say that here paper money buys an immunity from punishment, or that it is implicitly convertible into such an immunity. The mechanism is therefore somewhat analogous to convertibility, but it is not equivalent. First, this mechanism involves the government by definition, because only the government taxes. Convertibility, on the other hand, has been practiced by both governments and a wide variety of private entities. Second, in both mechanisms more interaction with the government means that more private agents face an exogenous pro-money behavior, which inspires general circulation of money. The difference is that in Aiyagari and Wallace (1997) and Li and Wright (1998) the government's crucial role is modeled as a seller of goods, while here it is modeled as a tax collector. In a modern economy the government sells very few goods in the marketplace, but its taxation is considerable.

In fact, my model does not really rely on any government involvement in, or monitoring of, trade: the government does not convert money into real goods, it does not directly force agents to trade with each other with fiat money (barter in itself is legal), and it does not force sellers to accept money from the government buyers. The only role of the government's trade here is to bring the money it collects back into the economy through its buyers, as real-life governments do. It could be assumed instead, without changing any result, that the government destroys the collected money and then injects new money by helicopter drops.

Is the policy optimal?

Proposition 2. (i) The pure monetary equilibrium has lower welfare than the monetary equilibrium. (ii) If y is small enough the pure monetary equilibrium is better than the non-monetary equilibrium.

many tax rates were determined so as to deliberately support monetary equilibria (Brock [1975]).

The proof is trivial. The result is a trade-off, very similar to the one in Aiyagari and Wallace (1997). In that model, the government supports money by refusing some barter opportunities. This means that some welfare is lost, compared to a monetary equilibrium without such policy. However, the resulting monetary equilibrium may be better than the non-monetary equilibrium that could exist if not for that policy. The only difference here is that the foregone barter opportunities are between private agents. The policy induces them to give up those possible trades, but guarantees the use of fiat money. Monetary trade is more likely to be the optimal form of trade if direct barter is difficult (i.e., y is small).

For the historical discussion below one more policy should be considered here. Suppose that the tax is denominated in goods rather than money. In particular, it is set at one good per taxpayer. In addition to accepting goods, tax collectors also accept money, but only according to its market value. If an agent pays in money and the money's market value is zero ($\Pi_\$ = 0$) then the tax collector forces this agent to produce, in addition, one good for him. A seller's value function is now

$$rV_0 = sy\Pi_0 \cdot \max_{\pi_0} \pi_0[U - C(1+t)] + M_\$ \cdot \max_{\pi_\$} \pi_\$[-C - t(1-\Pi_\$)C + (1-t)(V_\$ - V_0)] \tag{3}$$

Proposition 3. A policy of accepting money for taxes at market value is ineffective.

Proof. Set $\Pi_0 = 1$. Setting $\Pi_\$ = 0$ replicates the qualitative outcome of Proposition 1(i), while $\Pi_\$ = 1$ exactly replicates Proposition 1(ii). Proposition 1(iii) holds here too. $\square$

The key point with government intervention is that it introduces an exogenous behavior, which is unrelated to endogenous market expectations. Once the policy itself succumbs to these expectations and accommodates them it has no hope of influencing anything.

3 Competing Moneys

In reality dollar bills compete not only with barter but also with other moneys, including other outside moneys (say, euro, denoted e) and inside money (banknotes, denoted b). Let M_i, V_i, T_i, π_i, and Π_i, $i \in \{0, \$, e, b\}$, be the obvious generalization of the above notation. I consider these competing moneys separately.

3.1 Another Fiat Money

Suppose that euro bills have the same physical properties of dollar bills, including the storage cost c. To simplify the analysis I assume that currency trading of dollars for euros is impossible. Due to the symmetry between agents and between currencies, such trading could not be mutually beneficial in equilibrium, and thus would not occur anyway. The value functions are now determined as follows.

$$rV_0 = sy\Pi_0 \cdot \max_{\pi_0} \pi_0 \{U - C + t[T_0(-C) + (1 - T_0)(-P)]\} + M_\$ \cdot \max_{\pi_\$} \pi_\$ [-C + (1 - t)(V_\$ - V_0)] + \quad (4)$$

$$M_e \cdot \max_{\pi_e} \pi_e [-C + t(1 - T_e)(-P) + (1 - t)(V_e - V_0)]$$

$$rV_i = -c + s\Pi_i(U + V_0 - V_i) \quad (5)$$

for $i = \$, e$.

Proposition 4. If all objects are tax-receivable and $c < c_\exists$ there are four equilibria coexisting: a non-monetary equilibrium, a monetary equilibrium with the dollar as the unique money, a monetary equilibrium with the euro as the unique money, and a monetary equilibrium with both dollars and euros as money. There is no pure monetary equilibrium.

Proof. Essentially identical to the proof of Proposition 1.

Suppose that the government wants to promote dollars as money.

Theorem 2. The government can guarantee the *existence* and *uniqueness* of the pure monetary equilibrium with dollars iff $t > 0$ and the money's storage cost is small enough.

Proof. Set in (4) $T_0 = T_e = 0$. Setting $P = (U - C)/t$ is again sufficient to rule out barter (and therefore all the non-monetary and monetary equilibria). This punishment is also sufficient for ruling out the pure monetary equilibrium in which the euro is the unique money. A possibly higher punishment ($P = \frac{(1-t)(sU-c)-C(r+s)}{t[r+s+(1-t)M_{\$}]}$) is needed to rule out the pure monetary equilibrium in which both dollars and euros are money. This leaves only the pure monetary equilibrium with the dollar as the unique money. $\square$

In general, if there are n types of intrinsically useless objects with the same low storage cost, then without government intervention there are $\sum_{x=1}^{n} \binom{n}{x}$ pure monetary equilibria and the same number of monetary equilibria. Together with the non-monetary equilibrium, which always exists if the government does not intervene, there are $2^{n+1} - 1$ equilibria. The government can make any of the n objects the unique money in a unique pure monetary equilibrium.

3.2 Inside Money

Instead of euros assume now that there is another entity in the economy called a bank. It has a fixed location which is costlessly accessible to all agents between trading and taxation. The bank is monitored by the government and can therefore make commitments. It has a unique technology which enables it to produce banknotes, which are durable, indivisible, and consumed by nobody. Their advantage over dollar bills is that they have no storage cost. This advantage represents the convenience of banknotes compared with gold coins in the past, and the convenience of checks and electronic money compared with dollar bills today.

An agent who holds a dollar bill after a trade round can go to the bank, deposit the dollar bill, and receive a banknote instead. In return for this service the agent has to produce for the bank[12]. The bank consumes all the real goods. Any agent holding a banknote can go to the bank after a trade round and try to convert it into a dollar bill. There is no cost to such conversion. The bank keeps a 100% reserve ratio but might vanish with probability $1 - R$, where $R \in [0, 1)$. Therefore, conversion succeeds with probability R.

Let π_{ij}^S, $i, j \in \{\$, b\}$, be the strategy of a seller who just earned some money i and chooses whether to convert it at the bank into money $j \neq i$. Let π_{ij}^B be the similar strategy of a buyer who had money i before the last trade round and failed to spend it. Due to the increased complexity of the model, it is useful to let $y = 0$ here, and to assume that buyers cannot swap a dollar and a banknote among themselves. These simplifications do not affect the results. The value functions are now

$$rV_0 = (M_\$ - M_b) \cdot \max_{\pi_\$, \pi_{\$b}^S} \pi_\$ \{-C + (1-t)(V_\$ - V_0) + \pi_{\$b}^S[-C + t(1-T_b)(-P) + (1-t)(V_b - V_\$)]\} + \quad (6)$$

$$M_b \cdot \max_{\pi_b, \pi_{b\$}^S} \pi_b \{-C + \pi_{b\$}^S R(1-t)(V_\$ - V_0) + (1 - \pi_{b\$}^S R)[t(1-T_b)(-P) + (1-t)(V_b - V_0)]\}$$

$$rV_\$ = -c + s\Pi_\$(U + V_0 - V_\$) + (1 - s\Pi_\$) \cdot \max_{\pi_{\$b}^B} \pi_{\$b}^B(-C + V_b - V_\$) \quad (7)$$

$$rV_b = s\Pi_b(U + V_0 - V_b) + (1 - s\Pi_b) \cdot \max_{\pi_{b\$}^B} \pi_{b\$}^B R(V_\$ - V_b) \quad (8)$$

In (6) the probability of meeting a dollar holder depends on how many dollars are stored at the bank (i.e., how many banknotes are outstanding). A seller who just earned a dollar can exchange it for a

[12] Obviously he can produce only after he gives the dollar to the bank and before receiving the banknote.

banknote by producing for the bank. If he is taxed and the tax collector refuses to accept banknotes then he is punished. If he accepts a banknote in trade (second line of (6)) he can try to redeem it at the bank for a dollar bill. The motivation for this is the possibility that banknotes are not tax-receivable. Not only a recent seller can deposit a dollar at the bank: in (7) a buyer who fails to buy with a dollar can deposit it. Similarly, in (8), a buyer holding a banknote can convert it into a dollar. Since barter is ruled out by assumption, only pure monetary equilibria are possible.

Proposition 5. If all objects are tax-receivable, then: (i) the pure monetary equilibrium with dollars exists for some parameter values. (ii) for another set of parameter values there is a pure monetary equilibrium in which banknotes circulate and are used in tax payments, while all the dollar bills—although not rejected in trade—are actually always at the bank. (iii) if dollars are rejected in trade the pure monetary equilibrium with banknotes may or may not exist.

Proof. (i) Set in (6)-(8) $T_b = \Pi_\$ = 1$, $\Pi_b = 0$. Banknotes are rejected in trade ($\pi_b = 0$) iff $c \leq sU - \frac{(R+r)[r+s+(1-t)M_\$]M_\$ C}{[r+(1-t)M_\$][(1-t)(1-R)M_\$ - R(1+r)]}$ and $R < \frac{(1-t)M_\$}{(1-t)M_\$+1+r}$. It is optimal to convert banknotes into dollars ($\pi^S_{b\$} = \pi^B_{b\$} = 1$) iff $c < sU - \frac{sM_\$ C}{r+(1-t)M_\$}$. This condition is sufficient to prevent depositing of dollars ($\pi^B_{\$b} = \pi^S_{\$b} = 0$). The rest is exactly as in Proposition 1(ii). (ii) Set $T_b = \Pi_\$ = \Pi_b = 1$. Banknotes are accepted in trade iff $sU > \frac{r+s}{1-t}C$.[13] Dollars are deposited by sellers iff $c > \left(\frac{r+t}{1-t} - s\right)C$. This condition is sufficient for a buyer with a dollar to deposit it. It is never optimal to convert banknotes into dollars. (iii) With dollars rejected in trade, equations (6) and (8) are essentially the same as (1) and (2), only that the notation "b" replaces "\$" everywhere, there is no barter, and there is no storage cost. Thus Proposition 1 applies. □

Theorem 3. The government can guarantee the existence and uniqueness of the pure monetary equilibrium with dollars iff $t > 0$ and the money's storage cost is small enough.

Proof. Set $T_b = 0$ and $\Pi_\$ = 1$. It is easy to see in (6) that regardless of the value of Π_b, a high

[13] This is the same condition from Proposition 1(ii), only that here $y = 0$ and banknotes have no storage cost.

enough P results in rejection of banknotes in trade and no depositing of dollars. The rest is the same as in Theorems 1 and 2. $\square$

Note that the assumption $R < 1$ is critical. If the costless redemption is also riskless, then agents never reject banknotes even if the banknotes are not tax-receivable. The reason is the timing: the agents can go to the bank between trade and taxation and convert a banknote into a tax-receivable dollar.

As with any piece of paper, the circulation of a banknote, or a check, depends on agents' beliefs. The tax law does not say anything specific about these banknotes, so the tax collectors have full discretion whether to accept them or not. If they choose to reject them they can drive them out of circulation, but they can also choose to accept them and not interrupt this efficient use of a lighter medium of exchange.

4 Multiple Money Holdings

An obvious shortcoming of the model thus far is that agents never hold more than one object at a time. One might suspect that allowing more flexibility will allow agents to diversify their portfolios or at least be flexible about what they accept in payment. Assume then that agents can produce only if they hold up to one object of any type. This effectively increases the upper bound on money holdings from one unit to two units. Prices are still fixed for now at 1.

The point can be made by considering the economy with barter and only dollar bills as potential money. Let m_i, $i \in \{0, \$, \$2\}$, be the fraction of private agents holding i. For $i, j \in \{0, \$\}$, let Π_{ij} be the probability that a random seller holding i accepts j, and let π_{ij} be the best response of an agent who holds i and is offered j. Let $V_{\$2}$ be the value function of an agent holding \$2. The value functions are

$$rV_0 = (1-\gamma)(m_0\Pi_{00} + m_\$\Pi_{\$0})y \cdot \max_{\pi_{00}} \pi_{00}\{U - C + t[T_0(-C) + (1-T_0)(-P)]\}+ \tag{9}$$

$$[M-(1-\gamma)m_{\$2}]\cdot\max_{\pi_{0\$}}\pi_{0\$}[-C+(1-t)(V_{\$}-V_0)]$$

$$rV_{\$}=-c+(1-\gamma)(m_0\Pi_{00}+m_{\$}\Pi_{\$0})y\cdot\max_{\pi_{\$0}}\pi_{\$0}[U-C+t(V_0-V_{\$})]+ \tag{10}$$

$$[M-(1-\gamma)m_{\$2}]\cdot\max_{\pi_{\$\$}}\pi_{\$\$}[-C+(1-t)(V_{\$2}-V_{\$})]+$$

$$(1-\gamma)(m_0\Pi_{0\$}+m_{\$}\Pi_{\$\$})(U+V_0-V_{\$})$$

$$rV_{\$2}=-2c+(1-\gamma)(m_0\Pi_{0\$}+m_{\$}\Pi_{\$\$})(U+V_{\$}-V_{\$2}) \tag{11}$$

In the first line of (9) a seller meets a barter partner who has either \$0 or \$1. The second line describes a meeting with a buyer who has at least \$1. In (10) an agent with \$1 has three interesting matches. First, he may meet a barter partner. In this case, if he makes a sale he may be taxed and then he ends up with no money. Second, he may make another monetary sale and accumulate another dollar. Third, he may spend the money in shopping. In (11) the agent suffers the storage cost twice because he holds two dollar bills. He can only buy.

Proposition 6. (i) The government can guarantee that the non-monetary equilibrium does not exist iff $t>0$. (ii) For some parameter values the government can guarantee the existence of a monetary equilibrium. (iii) The government cannot guarantee the existence of a pure monetary equilibrium.

Proof. (i) Set $T_0=0$. By setting $P=(U-C)/t$ as before, moneyless agents will not barter ($\pi_{00}=0$). (ii) Also set $\Pi_{00}=0$, $\Pi_{\$0}=\Pi_{0\$}=\Pi_{\$\$}=1$. There is no closed-form solution because the distribution of money is too complicated. However, it can be verified that indeed $\pi_{\$0}=\pi_{0\$}=\pi_{\$\$}=1$ for the following parameter values: $U=5$, $C=1$, $M_{\$}=.5$, $r=.01$, $\gamma=.1$, $t=.25$, $y=.3$, $c=.01$. This means that agents always accept money, but they barter only if they already have money. (iii) No matter how high the punishment is, an agent who already has \$1 may still barter. The reason is apparent from (10): such an agent barters ($\pi_{\$0} = 1$) iff $U - C + t(V_0 - V_\$) > 0$. He cannot be punished. Although he does not earn money during this barter sale, he already has a dollar bill to begin with, so he can use that bill to pay the tax. $\square$

These results obviously generalize to any larger upper bound on money holdings. For the same reason, the government cannot guarantee equilibria without other outside or inside moneys. Any agent who already holds a dollar bill may trade in any other way, and pay that bill as a tax. On the other hand, the government can make sure that at least the moneyless agents do accept dollar bills in sales. The result is that the government's favorite money still circulates but not exclusively.

5 Endogenous Prices

Following Li and Wright (1998), I proceed by making goods divisible, while keeping everything else as in Section 2. This is not merely to check the robustness of the previous results, but also to show the robustness of the tax-foundation mechanism to money printing. As in Li and Wright (1998) and similar papers, a private agent now derives utility $u(q) \geq 0$ from consuming a quantity q of one of his preferred goods, and the cost of producing a quantity q is q. Also $u(0) = 0$, $u'(q) > 0$ and $u''(q) < 0$ for all $q > 0$. In meetings between sellers the bargaining power is equal, so both sides produce the efficient q^* which satisfies $u'(q^*) = 1$. In meetings between buyers and sellers, the buyers (whether private or public) make take-it-or-leave-it offers. The quantity produced in all other matches is denoted Q. The only new notation, compared with the literature, is q^t, which is the quantity that may be produced for the tax collector after a barter meeting. The value functions are now

$$rV_0 = sy\Pi_0 \cdot \max_{\pi_0} \pi_0 \{u(q^*) - q^* + t[T_0(-q^t) + (1 - T_0)(-P)]\} + M_\$ \cdot \max_{\pi_\$} \pi_\$ [-q + (1 - t)(V_\$ - V_0)] \quad (12)$$

$$rV_\$ = -c + s\Pi_\$ [u(Q) + V_0 - V_\$] \quad (13)$$

Assume that $q^t = V_\$ - V_0$. This makes the utility loss from tax identical for all taxpayers, regardless of how they pay.

Proposition 7. If all objects are tax-receivable, then: (i) the non-monetary equilibrium always exists. (ii) there are two monetary equilibria, which exist only for some parameter values. (iii) there is no pure monetary equilibrium.

Proof. (i) and (iii) are as in Proposition 1. (ii) Set $T_0 = \Pi_0 = \Pi_\$ = 1$. The bargaining rule implies $q = (1 - t)(V_\$ - V_0)$, which is strictly positive iff $c < s\{u(Q) - y[u(q^*) - q^*]\}$. A buyer's offer is $q(Q) = \max\left[(1 - t)\frac{s\{u(Q) - y[u(q^*) - q^*]\} - c}{r + s(1 - yt)},\ 0\right]$. □

These equilibria are shown in Figure 1, where an equilibrium is any intersection of the offer with the 45 degrees line (i.e., $q(Q) = Q$).

The uniqueness result of Theorem 1 is replaced by something weaker.

Proposition 8. The government can guarantee the existence of two pure monetary equilibria, and that no other equilibria exist, iff $t > 0$ and the money's storage cost is small enough.

Proof. Setting $P = [u(q^*) - q^*]/t$ and $T_0 = 0$ eliminates barter. Setting $\Pi_\$ = 1$ results in equilibrium iff $c < su(Q)$. A buyer's offer is $q(Q) = \max\left[(1 - t)\frac{su(Q) - c}{r + s},\ 0\right]$. □

The offer has the same shape as in Figure 1.

Now I show that the government can maintain the circulation of its favorite money even while it increases its supply and decreases its value. Suppose that at some date the government makes an unannounced, once and for all money injection. The money supply doubles and is given in proportional transfers, so that all agents, including government buyers, either have \$0 or \$2.[14]

For $i \in \{\$, \$2\}$, let n_i be the probability that a seller meets a buyer who offers i (note that the buyer might hold \$2 and yet offer only \$1), let q_i be the quantity demanded by such a buyer, let Q_i be the quantity produced in all other matches for i, let Π_i be the probability that a random seller accepts a payment i, and let π_i be the best response of a seller who is offered a payment i. The value functions are

$$rV_0 = sy\Pi_0 \cdot \max_{\pi_0} \pi_0\{u(q^*) - q^* + t[T_0(-q^t) + (1 - T_0)(-P)]\}+ \tag{14}$$

$$n_\$ \cdot \max_{\pi_\$} \pi_\$[-q_\$ + (1 - t)(V_\$ - V_0)] + n_{\$2} \cdot \max_{\pi_{\$2}} \pi_{\$2}[-q_{\$2} + (1 - t)(V_{\$2} - V_0)]$$

$$rV_\$ = -c + s\Pi_\$[u(Q_\$) + V_0 - V_\$] \tag{15}$$

$$rV_{\$2} = -2c + s\{(1 - \Pi_\$)\Pi_{\$2}[u(Q_{\$2}) + V_0 - V_{\$2}]+ \tag{16}$$

$$\Pi_\$(1 - \Pi_{\$2})[u(Q_\$) + V_\$ - V_{\$2}] + \Pi_\$\Pi_{\$2} \cdot \max[u(Q_{\$2}) + V_0 - V_{\$2},\ u(Q_\$) + V_\$ - V_{\$2}]\}$$

In (14), in addition to the usual possibility of barter, there is also the possibility of meeting a buyer who offers \$1 for $q_\$$, and a buyer who offers \$2 for $q_{\$2}$. Meeting with a tax collector results in a total loss of that monetary income, whether it is \$1 or \$2 (in accordance with the tax law). In (16), note that the storage cost is incurred twice. This buyer might meet a seller who accepts only \$2, a seller who accepts only \$1, or a seller who accepts either \$1 or \$2. In the latter case, the buyer chooses how much to pay.

[14] Recall that throughout the paper agents are not physically prevented from holding more than \$1 at a time. Only restriction on their production capabilities prevent such accumulation in most of the paper. I maintain here the assumption (relaxed in the previous section) that only moneyless agents can produce.

Theorem 4. The government can still guarantee the existence of two pure monetary equilibria, and that no other equilibria exist, iff $t > 0$ and the money's storage cost is small enough. All payments are of \$2. The threshold storage cost is smaller than in Proposition 8. The price level is almost exactly twice as it was before the increase in the quantity of money.

Proof. Setting $P = [u(q^*) - q^*]/t$ and $T_0 = 0$ eliminates barter. Setting $\Pi_{\$} = 0$ and $\Pi_{\$2} = 1$ results in equilibrium iff $c < su(Q)/2$. A buyer's offer is $q(Q) = \max\left[(1-t)\frac{su(Q)-2c}{r+s},\ 0\right]$. □

The only change is that after the increase in the quantity of money all buyers carry twice as much money. Every trade involves a payment of \$2. Dollar bills need to be even lighter now to sustain the pure monetary equilibria. The added cost also affects the bargaining outcome, and thus the curve in Figure 1 is a bit lower in this case. Depending on which equilibrium is realized, the output per meeting can be slightly higher or lower than before. Given that almost the same quantity of real goods is traded for twice as much money, money is almost neutral. The important point is that guaranteeing the circulation of money is almost as easy with more money than with less money. Put differently, the transfer is neutral not only in terms of allocations, as could be expected, but also in terms of the strength of the monetary equilibria and the policy's viability. Of course, even these small changes in allocations can be avoided if the government orders that every two dollar bills must be converted into one "new dollar" bill.

Section 2 shows that the tax-foundation mechanism is similar to convertibility in its ability to guarantee *circulation*. However, it cannot guarantee the *value* of fiat money (Woodward [1995], p. 929) because it enables the money supply—unlike with convertibility—to be completely discretionary. The government can print money at will, causing higher prices, higher nominal incomes—and higher nominal tax obligations. The price of immunity from the tax collectors' punishment increases proportionately, and therefore the money's acceptability is sustained.

While some see this "indeterminacy" of the price level as a fatal flaw for a theory of money (e.g., Ellis [1934], Klein [1974]), abusive governments have realized that this "indeterminacy" is their ultimate victory: they can guarantee that their money is acceptable (as with convertibility), even though they can print more of it at will. The tax-foundation mechanism allows a government to have its cake and eat it too. Therefore, this "indeterminacy" of the price level is not a reason to ignore the tax-foundation theory, but rather a crucial reason for economists to understand it.

6 Monetary History

In this section I discuss the relevance of the model to reality. Parts of the tax law described in Section 2 are in the legal tender law of every modern country. Every such country declares at least one type of fiat money to be legal tender for taxes (and contractual debts). Usually only one type of fiat money—that issued by the domestic government—has this status[15]. The tax collecting authority cannot reject tax payments made in the various objects that belong to this type of money (i.e., the various coins and notes of different denominations). As for all other objects—such as checks, used cars, grain, or paper money of the game Monopoly—the legal tender law is silent. Standard legal principles dictate that this silence grants the tax-collecting authority complete discretion on whether to accept such objects in tax payments. It just so happens that most tax-collecting authorities accept checks but reject anything else.

Casual evidence is clearly favorable to the hypothesis that there is a relation between what is declared legal tender and what circulates as money. Given political and economic stability, indeed the domestic legal tender is typically the general medium of exchange. Countries and currency unions seem to be able to change currency at will, as recently seen in Iraq and the European Union. As Goodhart (1998) notes, money tends to follow political unification and disintegration of federations (e.g., German and Soviet currencies, 1871-1991).

[15] "United States coins and currency (including Federal Reserve notes and circulating notes of Federal Reserve Banks and national banks) are legal tender for all debts, public charges, taxes, and dues." (United States Code, Title 31, Section 5103).

It is easy to find cases of fiat moneys which failed even though they were receivable for taxes. The first task of this section is to show that such cases can be explained *within* the model and the theory outlined above. Some economists are quick to cite many cases of fiat moneys that supposedly circulated without being receivable for taxes. If true, this would mean that the tax-foundation mechanism is not necessary in practice and perhaps contributes nothing. The second task of this section is to show that there is very little substance in such evidence. By and large, both the successes and failures of fiat moneys in reality seem to be related to the tax-foundation mechanism.

6.1 Failures of the Tax-Foundation Mechanism

The model developed above is helpful in explaining why sometimes an object is receivable for taxes and yet does not circulate.

6.1.1 Non-Unique Legal Tender

The Civil War's greenbacks were rejected in the West Coast (Mitchell [1903]) even though they were legal tender for taxes. Their failure is consistent with the theory because gold was also legal tender. Proposition 1 shows that if all objects are receivable for tax payments ($T_i = 1 \ \forall i$), a fiat money equilibrium always coexists with an equilibrium without fiat money. More recently, the American public has rejected the half-dollar coin, the Susan B. Anthony dollar, and the two-dollar bill. According to Proposition 4 if two types of fiat money have the same storage cost and both are receivable for taxes, then either one of them or both may circulate. Since people do not have to pay taxes in coins and notes of particular denominations, the failure of some denominations does not contradict the theory. In both cases, then, the model features multiple equilibria. Indeed, other evidence shows the exact opposite behavior: during the Revolutionary War gold was hoarded while the paper continental was used in trade (Calomiris [1988]); and the recent Sacagawea golden dollar coins were happily received by sellers but were hoarded instead of being spent (Lotz and Rocheteau [2002]).

6.1.2 Regime Transition

The observed correlation between a paper money's circulation and the existence of its issuing regime is highly positive but not perfect. Saddam Hussein's money circulated in Iraq half a year after his regime collapsed. On the other hand, Germans abandoned their paper money a few months before the Nazi surrender (Einzig [1966], p. 299). These observations are not inconsistent with the theory. All the propositions and theorems above that show the government's power to promote its favorite currency are careful to include the condition $t > 0$, where $t \equiv \tau G$ is the expected probability of being taxed in the future by a government that accepts this currency (recall that τ is the probabilistic tax rate and G is the government's survival probability). In such episodes of extreme political instability it is not the current policy of the current government that matters, but the subjective expectations regarding the future government and its policies (Goodhart [1998], King [2004]). Iraqis expected the Coalition Provisional Authority to convert Hussein's money into its new legal tender, so there was no reason to reject it. Russians' acceptance of the dead czar's money during the chaotic hyperinflation of the 1920s (Friedman [1992], p. 11-12) can also be explained by a belief that whoever ends up in power would either convert that money or accept it in various payments. The Germans' premature abandonment of their money can reflect expectations that the Allies would treat them harshly and not conduct such a conversion[16].

[16] Alternatively, perhaps they expected to be treated the way they treated some occupied peoples. It is well known what monetary theory predicts regarding fiat money in finite horizon economies.

6.1.3 Ineffective Tax System

The mechanism may fail if the tax system is not functioning (Wray [1998], p. 36), i.e., $\tau = 0$. This may be the case even if the government is expected to remain in power. This is particularly true for new regimes because it takes them time to construct effective tax systems that will detect and punish tax offenders severely enough. This may explain the failure of Japanese money right after Japan occupied Taiwan in 1895 (Li and Wright [1998]), and the problems of new fiat moneys in disintegrated federations where tax collection was not important beforehand—the Confederacy during the American Civil War (Lerner [1956]) and formerly communist countries. Recalling the similarity to convertibility, it is similar to a situation where the Treasury's gold holdings are lost or expected to be lost. With no immunities to sell to the taxpayers, the fiat money becomes unbacked.

The government may denominate the tax in one unit of account and accept another money as well. If it accepts the other money according to market value rather than at a pre-determined exchange rate, there is nothing to prevent the collapse of the other money, as shown in Proposition 2. An equilibrium in which both the market and the tax authority see that money as valueless always exists. This actually happened with the continental currency of the American Revolution (Calomiris [1988], p. 59) and the mandat currency of the French Revolution (Nussbaum [1950], p. 50).

6.1.4 Non-exclusive Circulation

In many countries the legal tender currency circulates side by side with foreign currency. It is especially common in periods of high inflation, in which people prefer a foreign, stable currency whenever possible. As shown in Proposition 6, when agents can hold more than \$1, sometimes they might choose to conduct transactions in other ways. They may do so as long as they already hold the minimum they need for tax payments in the domestic currency. This is an important constraint on the government's power and the extent to which it can encourage the use of its favorite money in trade. However, it does not completely contradict the theory. At least occasionally agents do demand the domestic currency because they need it for tax payments. It is probably this demand that keeps the price level finite even after people realize that their government is bent on hyperinflation.

6.2 Is Tax Receivability Necessary?

The high positive correlation between the existence of regimes and the success of their currencies raises an intriguing possibility. Perhaps some government intervention is *necessary* to support the value of fiat money. If a certain type of paper money is neither supported by convertibility nor tyrannically forced on all transactions, does it have to be receivable for taxes in order to circulate? Standard monetary models say that this is not the case: pure expectations can sustain the circulation of any fiat money. However, as Prescott and Rios-Rull (2005) show, such monetary equilibria collapse once any agent can issue his own fiat money. And what prevents each one of us, in reality, from starting our own system of fiat money?

It is very easy to find references in the literature to currencies that were supposedly intrinsically useless, inconvertible, and not legal tender. A detailed discussion is beyond the scope of this paper (see Goldberg [2006]). Here I briefly explain why there is little substance in such popular claims. Bank deposits and checks are not legal tender and are not convertible into goods or services. However, they are convertible by law into some legal tender. As shown in Subsection 3.2 the tax authority may or may not encourage the use of such inside money in trade and tax payments. Similar to checks are modern private banknotes in Scotland and Northern Ireland, which have never been legal tender. They too are legally convertible into some legal tender (Bank of England notes). Private, non-bank local moneys such as the Ithaca HOURS have been either convertible into the issuers' goods and services (in which case they are not fiat money), or convertible into the domestic legal tender. One rare exception is the recent system of *creditos* in Argentina. Hundreds of such private moneys were issued, typically with no promise of convertibility. They circulated briefly before they all collapsed. This fast collapse and the large number of issuers are more consistent with the aforementioned Prescott-Rios-Rull result than with standard monetary models' prediction that fiat money can circulate based on pure expectations.

Among government-issued currencies there are many false examples. The paper moneys of most American colonies, Bank of England notes during the Napoleonic Wars, and notes issued by towns in the U.S. in the nineteenth century, have been cited as not having a legal tender status. The truth is that these currencies were legal tender for taxes but not for contractual debts. That is, their success is clearly explained by the tax-foundation theory. Similarly, Confederate money of the American Civil War, mentioned in the opening quote of this paper, was legal tender for taxes and for debts to banks, but not legal tender for other contractual debts. Federal Reserve notes had been legal tender only for taxes while they were convertible. Recently, Governor of the Bank of England Mervyn King (2004) mentioned that Hussein's older money continued circulating in Kurdish Iraq from 1993 to 2003, even though its legal tender status had been revoked by Hussein. However, King's claim that this money was no longer supported by *any* government is incorrect. The money was declared legal tender by the Kurdistan Regional Government that actually controlled the area[17].

Another common claim is that traditional societies have used intrinsically useless, inconvertible, non-paper objects as money. The most famous examples are the stone money of the Island of Yap and seashells. As I prove in Goldberg (2005), such claims ignore (unwritten) local laws and religion, and falsely assume that if an object seems intrinsically useless to a modern Western person then it was also considered as such by the natives.

It seems therefore, that if a currency has no other anchor (intrinsic value, convertibility, tyrannical forced usage in all commercial transactions), it can circulate in the long run only if it is receivable for taxes. Of course, a scientific theory has to be refutable. The challenge here for the theory's opponents

[17] Private communication with Mr. Nijyar Shemdin, the U.S. Representative of the Kurdistan Regional Government, 01/12/2004.

is to find an example of a currency that circulated for a long time without having *any* such anchor. As far as I know, no such examples exist. The U.S. Congress actually tried something like that. In the antebellum period it authorized the Mint to issue copper coins but refused to grant them any other legal status. Not surprisingly, the public indeed rejected this money (Carothers [1930]).

7 Conclusion

In the real world, there is more to government-issued fiat money than intrinsic uselessness and inconvertibility: its acceptance in tax payments is guaranteed. Generally, no other objects can be forced on the tax authority. This paper makes three contributions. First, it uses a monetary search model to prove in a dynamic model that receivability for taxes can make fiat money the general medium of exchange. Second, it explores the similarity and differences between this mechanism and convertibility and discusses its limitations. Third, it sets some of the record straight regarding the complex relations between fiat moneys and their issuers.

There are many ways for a government to promote the circulation of its paper money. The ideal way would assure money-holders that their money could be put to good use, be robust to inflation in the sense that the money will not be completely abandoned, and be easy and cheap to implement. That ideal way could be the tax-foundation mechanism. Its assurance that the money can be put to good use was shown above to be somewhat equivalent to convertibility. Its robustness to inflation was also shown above in that circulation is maintained even while prices increase. As for implementation, this method is also the cheapest. There is no need to obtain and store gold. There is no need to monitor market transactions. There is no need to conduct searches for illegal currencies. Given that the government collects taxes anyway, it can easily promote any money simply by insisting on accepting only that money.

As mentioned in the Introduction, the tax-foundation theory is part of Knapp's (1905) state theory of money. He celebrated the fact that the government determined what was money and he showed complete indifference towards the quantity of money and inflation. His theory became very popular in his native Germany and was viewed by German policy-makers as a license to print money. The disastrous results are well-known. By contrast, the goal of the current paper is to promote understanding of this menace and its fortunate limitations so that we can better protect ourselves from it. It is my hope that this paper contributes to such understanding.

References

Aiyagari, S. R., and N. Wallace, 1997, Government Transaction Policy, the Medium of Exchange, and Welfare, Journal of Economic Theory 74, 1-18.

Brock, L. V., 1975, The Currency of the American Colonies, 1700-1764 (Arno Press, New York).

Calomiris, C. W., 1988, Institutional Failure, Monetary Scarcity, and the Depreciation of the Continental, Journal of Economic History 48, 47-68.

Carothers, N., 1930, Fractional Money (John Wiley & Sons, New York).

Cowen, T., and R. Kroszner, 1994, Explorations in the New Monetary Economics (Blackwell, Cambridge).

Ellis, H. S., 1934, German Monetary Theory: 1905-1933 (Harvard University Press, Cambridge).

Einzig, P., 1966, Primitive Money (Pergamon, Oxford).

Forstater, M., 2006, Tax-Driven Money: Additional Evidence from the History of Thought, Economic History, and Economic Policy, in: M. Setterfield, ed., Complexity, Endogenous Money, and Macroeconomic Theory (Edward Elgar, Cheltenham).

Friedman, M., 1992, Money Mischief (Harcourt Brace Jovanovich, New York).

Goldberg, D., 2002, On the Implicit Convertibility of Fiat Money, Chapter 1 in Search and Money, Ph.D. Dissertation, University of Rochester.

Available online at http://econweb.tamu.edu/dgoldberg/research/dissertation/chapter1.pdf

———, 2005, Famous Myths of "Fiat Money," Journal of Money, Credit, and Banking 37, 957-967.

———, 2006, The Legal Status of Modern Currency, working paper, Texas A&M University. Available online at http://econweb.tamu.edu/dgoldberg/research/legal.pdf

———, 2007, The Dishonest Origins of Modern Currency, working paper, Texas A&M University. Available online at http://econweb.tamu.edu/dgoldberg/research/MA.pdf

Goodhart, C. A. E., 1998, The Two Concepts of Money: Implications for the Analysis of Optimal

Currency Areas, European Journal of Political Economy 14, 407-432.

Grossman, H. I., 1991, Monetary Economics—A Review Essay, Journal of Monetary Economics 28, 323-345.

King, M., 2004, Ely Lecture: The Institutions of Monetary Policy, American Economic Review 94, 1-13.

Klein, B., 1974, The Competitive Supply of Money, Journal of Money, Credit, and Banking 6, 423-453.

Knapp, G. F., 1905, The State Theory of Money. English edition, 1924 (Macmillan, London).

Lerner, A. P., 1947, Money as a Creature of the State, American Economic Review, Papers and Proceedings of the American Economic Association 37, 312-317.

Lerner, E., 1956, Inflation in the Confederacy, 1861-1865, in: M. Friedman, ed., Studies in the Quantity Theory of Money (University of Chicago Press, Chicago).

Li, Y. and R. Wright, 1998, Government Transactions Policy, Media of Exchange and Prices, Journal of Economic Theory 81, 290-313.

Lotz, S. and G. Rocheteau, 2002, On the Launching of a New Currency, Journal of Money, Credit, and Banking 34, 563-588.

Mitchell, W. C., 1903, A History of the Greenbacks (University of Chicago Press, Chicago).

Nussbaum, A., 1950, Money in the Law, National and International (The Foundation Press, Brooklyn).

Prescott, E. C., and Rios-Rull, J. V., 2005, On the Equilibrium Concept for Overlapping Generations Economies, International Economic Review 46, 1065-1080.

Sargent, T. J., 1982, The Ends of Four Big Inflations, in: R. E. Hall, ed., Inflation: Causes and Effects (University of Chicago Press, Chicago).

Selgin, G. A., 2003, Adaptive Learning and the Transition to Fiat Money, Economic Journal 113, 147-165.

Shi, S., 2005, Nominal Bonds and Interest Rates, International Economic Review 46, 579-612.

Smith, A., 1776, The Wealth of Nations. 1952 edition (William Benton, Chicago).

Smith, B. D., 1985, Some Colonial Evidence on Two Theories of Money: Maryland and the Carolinas, Journal of Political Economy 93, 1178-1211.

Soller-Curtis, E., and C. J. Waller, 2000, A search-theoretic Model of Legal and Illegal Currency, Journal of Monetary Economics 45, 155-184.

Starr, R. M., 1974, The Price of Money in a Pure Exchange Monetary Economy with Taxation, Econometrica 42, 45-54.

———, 2003, Why is There Money? Endogenous Derivation of 'Money' as the Most Liquid Asset: A Class of Examples, Economic Theory 21, 455-474.

Wallace, N., 1981, A Modigliani-Miller Theorem for Open Market Operations, American Economic Review 71, 267-274.

Woodward, G. T., 1995, Interest-Bearing Currency: Evidence from the Civil War Experience: Comment. Journal of Money, Credit, and Banking 27, 927-937.

Wray, L. R., 1998, Understanding Modern Money (Edward Elgar, Cheltenham).

Figure 1: Equilibria with Endogenous Prices