On the Origins of Money*

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Abstract

The standard view in economics is that money grew out of the inefficiency of barter. Although logically appealing, this view is inconsistent with the evidence that money often replaced fairly sophisticated credit arrangements. In this paper, we develop a model of the emergence of money in which money is introduced by fiscal, not efficiency, reasons. By linking past production to future consumption, money impedes surplus creation by preventing exchanges in which consumption precedes production. This link favors surplus extraction, though. So, a fiscal authority may prefer money over credit even if the latter promotes greater gains from trade.

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"Just about every economics textbook employed today sets out the problem the same way. Historically, they note, we know that there was a time when there was no money. What must it have been like? Well, let us imagine an economy something like today's, except with no money. That would have been decidedly inconvenient! Surely, people must have invented money for the sake of efficiency. The story of money for economists always begins with a fantasy world of barter." (Graeber 2011, p. 23)

1 Introduction

The standard economic explanation for the emergence of money is that it grew out of the inconveniences of barter; namely, lack of double coincidence of wants (Jevons, 1875 and Menger, 1892), lack of divisibility of commodities (Smith, 1776), and private information about the quality of goods (Brunner and Meltzer, 1971 and Alchian, 1977). Modern monetary theory has been successful in showing formally why agents would prefer a medium of exchange over barter (e.g., Kiyotaki and Wright, 1989, Williamson and Wright, 1994, and Barnerjee and Maskin, 1996).

However appealing, this explanation does not square well with existing evidence. History and anthropology alike emphasize that money usually replaced fairly sophisticated credit arrangements (e.g., Einzig, 1948, Quiggin, 1949, and Graeber, 2011) and that in its few documented instances, barter grew out of the demise of money, as in the fall of the Roman Empire (Graeber, 2011) and the Soviet Union (Seabright, 2000). This evidence casts a shadow on the idea that the emergence of money is linked to efficiency considerations.

In this paper, we propose a fiscal explanation for the emergence of money in which credit, and not barter, is the alternative to money. Our main result is that money may be introduced in the economy not to foster surplus creation, but to enhance surplus extraction, even if the latter can lead to a reduction of the former. This result is consistent with the historical evidence that money was introduced when a central ruler reorganized its fiscal apparatus of tax collection, as for example in Persia (Babelon, 1893) and in Egypt (Le Rider, 2003).

The intuition for our result is the following. The key advantage of credit over money from a surplus-creation perspective is that credit decorrelates consumption and production, i.e., while agents need to chase money in order to chase goods, credit does not require production to precede consumption. This benefits surplus creation by permitting more exchanges to take place. However, from a surplus-extraction perspective, the information provided by credit is more opaque than the one provided by money. In fact, through its use as a means of payment, money links production decisions with money holdings, allowing the fiscal authority to tax the entire surplus created through exchange and only leave to producers a tax deduction that compensates them for their effort to acquire money.[1] In contrast, credit, by severing the link from production to consumption, looses track of how the effort to create surplus is distributed in the economy, hurting the ability of the fiscal authority to tax the surplus created by agents. To say it in other words, in credit economies, the decorrelation between production and consumption generates a misalignment between surplus creation and surplus extraction, favoring the former but hurting the latter. In a monetary economy, the link between production and consumption at the heart of a monetary trade hurts surplus creation by constraining exchange opportunities but favors surplus extraction by allowing a finer detection of those that need to be incentivized to participate in trade.

The fiscal rationale for the origin of money that we advance here is quite different from the so-called tax-foundation theory of money (Ellis, 1934 and Lerner, 1947).[2] According to the latter, it is the monopoly of the government in the issuance of money and the ability to force its use in the payment of taxes that explains the introduction of money in the economy. There are two main differences between our explanation and the tax-foundation theory. First, credit and taxation already existed before the introduction of money, so one has to deal with the issue as to how money fares compared to credit in terms of surplus creation and extraction. The tax-foundation theory is silent about this comparison.[3] Second, while in our economy taxes can be paid in goods and money is valued due to its use as a medium of exchange, in the

[1] As we are going to show, this does not imply that those without money are more heavily taxed than those with money—in fact, the opposite takes place. It only means that those with money get a deduction out of their taxes that is commensurate with their effort to acquire money.

[2] See Forstater (2006) for a survey on the history of economic thought on the tax-foundation theory. A similar approach is advanced by the state theory of money, also called chartalism (Graeber, 2011).

[3] For example, Goldberg (2012) provides a model of the tax-foundation theory in which agents can choose between trading with money and bartering. The model fits well the purpose of explaining the benefits of imposing tax payments in money, but it keeps the world of barter in the background.

tax-foundation theory the value of money hinges on the fact that it is used to pay taxes. The implication is that, while seigniorage and inflation are central elements to the tax-foundation theory, they are of second-order importance in our explanation.

We introduce our model in Section 2. We consider an economy populated by a continuum of small individuals, the agents, and by one large individual, the government. The agents can trade among themselves. Trade, however, is decentralized and subject to a lack of double coincidence of wants problem, and so can take place only in the presence of a technology of exchange. We consider two such technologies, credit and money. We model credit as either a multilateral system of reciprocal exchange, as in archaic Greece (Van Reden, 2010), or as a bilateral arrangement between a creditor and a debtor, as in Mesopotamia (Renger, 1995) and Egypt (Van Reden, 2007).[4] We model money as a durable and indivisible good with no intrinsic value (Kiyotaki and Wright, 1993).[5] The government raises revenues by taxing the agents who engage in trade.

We begin our analysis in Section 3 by discussing the feasibility of trade in the credit and monetary economies. The feasibility of trade depends on agents having an incentive to engage in costly production. The feasibility of trade also depends on the gains from trade, as these determine how much agents can benefit from it—the lower the gains from trade, the harder to sustain trade, as agents have less to gain from it. Both the gains from trade and the incentives to engage in costly production depend on the technology of exchange. We show that while in the credit economy trade is feasible if, and only if, the gains from trade are sufficient to compensate all agents for the cost of production, even the ones who do not produce, in the monetary economy trade is feasible if, and only if, the gains from trade are sufficient to compensate the agents who actually engage in trade. This result plays a key role in our subsequent analysis.

We consider government taxation in Section 4. Government revenues from taxation in a given economy are limited by the maximum gains from trade possible in the economy. These revenues are also constrained by the fact that the government must leave some of the

[4] The analysis of bilateral credit is relegated to the Appendix as it brings no insights relative to our simpler model of multilateral credit.

[5] We also consider the case of divisible money, as in Lagos and Wright (2005).

gains from trade for the agents, so as to provide them with an incentive to trade. We derive expressions for the government's optimal taxes in both the credit and monetary economies and show that in either economy the (optimal) government revenue from taxation is positive only if trade is feasible.

We compare government revenues from taxation in the credit and monetary economies in Section 5. A key consequence of the results derived in Section 4 is that the surplus the government has to leave in the agents' hands in order to provide them with the incentive to trade is smaller in the monetary economy than in the credit economy. We first show that this result is driven by the fact that in the monetary economy the government is able to better track how the effort to create surplus is distributed in the economy, allowing for a more targeted taxation. We then use this result to show that the government may prefer monetary trade to credit trade even if the gains from trade generated by the former are smaller than the gains from trade generated by the latter. This result holds when the ability of credit to promote trade is intermediate. If credit is too efficient at promoting trade, then the additional surplus created by credit more than offsets the loss in surplus extraction. On the other hand, if credit is too inefficient at promoting trade, then money dominates as a tool for both surplus creation and surplus extraction.

We discuss the related literature in Section 6 and how our results relate to historical evidence in Section 7. Section 8 offers some final remarks. Appendix A contains some robustness exercises and Appendix B discusses several extensions.

2 Model

Time is discrete and indexed by $t \in \mathbb{Z}$. The economy is populated by a unit mass of non-atomic individuals, the agents, and by one large individual, the government. Both the agents and the government are infinitely lived, have the same discount factor $\beta \in (0, 1)$, and maximize the present discounted sum of their expected flow payoffs.

There are two types of non-storable goods in the economy, a special indivisible good and a general divisible good. The agents can produce both types of good, while the government cannot produce either type of good. The cost to the agents of producing one unit of the special good is $c > 0$, whereas the cost to the agents of producing x units of the general good is x. The agents obtain utility $u > c$ from consuming one unit of the special good and obtain no utility from consuming the general good. The government obtains no utility from consuming the special good and obtains utility x from consuming x units of the general good. So, only the exchange of the special good generates gains from trade and the general good allows the transfer of surplus from the agents to the government.

Agents have two alternatives. They can either trade the special good in a decentralized market, where they pay taxes to the government by producing the general good to it, or they can move to autarky, where they pay no taxes to the government but trade is not feasible. Autarky is absorbing and its flow playoff is zero.[6] We discuss the role of autarky below.

The sequence of events in a period is as follows. First, the government announces next period's taxes, after which the agents decide whether to enter the market and trade or move to autarky. The agents who enter the market first pay taxes to the government. Then, they meet randomly and anonymously in pairs. Only one agent in a match can produce the special good and each agent in the match is equally likely to be the producer. Finally, matched agents decide on the terms of trade.

Since meetings in the decentralized market are random and anonymous and there are no double coincidence of wants, trade can only take place in the presence of a technology of exchange. We consider two such technologies, credit and money, that we now describe.

In the credit economy, there exists a monitoring technology that keeps track of the behavior of the agents in the market. In every period, this technology is available in a pairwise meeting with probability $\lambda \in [0, 1]$. The parameter λ describes the extent to which trade between agents is possible in the credit economy and plays an important role in our analysis.[7] In a monitored meeting, the actions of the agents are recorded and the agents are assigned either a good or a bad label. In a non-monitored meeting, the actions of the agents are not recorded and agents keep the label they had before participating in the meeting. All agents

[6]Since agents never move to autarky in equilibrium, the assumption that autarky is absorbing is without loss.
[7]We provide a more detailed discussion of this parameter in Section 5.

initially have a good label. An agent with a good label is assigned a bad label if the agent is a producer in a monitored meeting, the agent's partner has a good label, and the agent does not produce in the meeting, otherwise the agent keeps the good label. Once an agent gets a bad label, the agent stays with this label forever after.

In the monetary economy, there exists a durable and indivisible good, money, which has no intrinsic value. We assume that each agent can hold at most one unit of money, so that there exists no intensive margin to trade. Besides taxes, the stock of money is also a choice variable for the government in the monetary economy.

Remarks. The assumption that $t \in \mathbb{Z}$ simplifies our analysis by implying that there exists no first period in the government's problem, and so no period has privileged status relative to other periods. It follows from our analysis that if there exists a first period in the government's problem, then in every period but the first the incentives faced by the government in the credit (respectively, monetary) economy are the same as in the credit (respectively, monetary) economy without a first period in the government's problem. This, in turn, implies that in every period after the first, the government's optimal revenue from taxation in either economy is the same as when there exists no first period in the government's problem.

In our model, the government is able to set next period's taxes at the beginning of each period. This assumption can be motivated on the grounds that there exists a lag between tax choices and tax collection. Moreover, as we show in Section 4, trade is not feasible without one-period commitment to taxes by the government.

The assumption that the government's payoff from consuming the general good equals its production cost implies that taxation does not destroy surplus. This allows us to focus on our main objective—comparing how different technologies of exchange, money and credit, affect the ability of the government to extract surplus from agents—in the most transparent way possible. Our results are qualitatively the same if the government's payoff from consuming x units of the general good is ρx with $\rho \in (0, 1)$, so that taxation destroys surplus.

The possibility of moving to autarky captures the idea that agents can, at some cost, avoid government taxation. In Appendix B.1, we extend our model to the case in which the agents' flow payoff from autarky is $A \geq 0$. Greater values of A reflect smaller state capacity in the sense that the government is less able to punish tax avoidance. There, we show that while the government's optimal revenue from taxation in the credit economy does not depend on A (as long as A is not so large that agents prefer autarky over trade even without government taxation), the government's optimal revenue from taxation in the monetary economy decreases with A. Thus, our model generates the prediction that increases in state capacity can lead a central ruler to switch from credit to monetary trade.

Our model of credit is a model of risk-sharing enforced by a monitoring technology. As mentioned in the Introduction, this is consistent with credit arrangements observed in some primitive societies (Van Reden, 2010). In Appendix B.2, we consider a model of bilateral credit enforced by a monitoring technology and show that our results are qualitatively the same. We favor the analysis of the risk-sharing model of credit as it is simpler and delivers the same insights as the more complex model of bilateral credit.

The assumption that money is indivisible and there exists a unit upper bound on money holdings simplifies the analysis of the monetary economy. In Appendix B.3, we consider a monetary economy with divisible money and no upper bound on money holdings along the lines of Lagos and Wright (2005) and show that our results are qualitatively the same.

3 Feasibility

We begin our analysis by examining the feasibility of trade in the credit and monetary economies. In order to do so, we shut down the government so that only technological constraints affect the agents' trading decisions. We will see in the next section that government taxation is possible only if, and only if, trade is feasible.

3.1 Credit Economy

In the credit economy, trade can take place only in monitored meetings, as producers in non-monitored meetings cannot be punished for not producing to their partners. We consider the credit arrangement in which trade takes place in a monitored meeting only if both agents in the meeting have a good label. This arrangement maximizes gains from trade in the credit economy. Doing so is natural given that our focus is on explaining how a government would prefer a less efficient trading technology to a more efficient one.

In every period, an agent who enters the market participates in a monitored meeting with probability λ. Provided trade is incentive compatible, in any such meeting the agent is a producer with probability one half, incurring cost c, and is a producer with the remaining probability, obtaining payoff u. So, provided trade is incentive compatible, the (expected) flow payoff to an agent with a good label who enters the market in every period is $\lambda(u-c)/2$, implying a (present-discounted) lifetime equal to

$$U^C = \frac{\lambda(u-c)}{2(1-\beta)}. \tag{1}$$

The participation constraint for trade is $U^C \geq 0$, while the incentive-compatibility constraint for trade is

$$\beta U^C \geq c. \tag{2}$$

In order to understand (2), note that a producer with a good label incurs a cost c to keep the good label, and so has an incentive to do so only if the continuation payoff from having this label is greater than the cost. Clearly, the agents' participation constraint is satisfied if trade is incentive compatible. The next result follows immediately from this observation together with (1) and (2).

Proposition 1. *Trade is feasible in the credit economy if, and only if,*

$$\frac{\lambda(u-c)}{2} \geq \frac{(1-\beta)c}{\beta}. \tag{3}$$

The left-hand side of (3) is the flow welfare in the credit economy. Indeed, $(u-c)/2$ is the (expected) gain from trade in a meeting in which trade takes place and λ is the fraction of such meetings in the economy. The right-hand side is the smallest flow payoff an agent with a good label must receive for trade to be incentive compatible. Thus, trade is feasible in the credit economy if, and only if, the gains generated by trade are sufficient to provide agents with a good label with the incentive to produce in a monitored meeting. Note that all else constant, by increasing realized gains from trade, an increase in the fraction of monitored meetings increases the region of the parameter space under which trade is feasible in the credit economy.

To conclude the discussion of feasibility in the credit economy, note that by permanently excluding an agent with a bad label from trade, the credit arrangement we consider implies that a producer's continuation payoff in case the producer has a good label and fails to produce in a monitored meeting is the lowest possible, providing producers with the greatest incentive possible to trade. Any other credit arrangement implies a higher continuation payoff for an agent with a bad label, in which case the critical threshold for the agents' continuation payoff above which trade is incentive compatible—the right-hand side of (3)—is higher. This reduces the set of parameters for which trade is feasible in the credit economy.

3.2 Monetary Economy

In the monetary economy, trade can take place only in meetings in which the consumer has money and the producer does not have money. We consider the monetary arrangement in which the producer in such a meeting produces to the consumer in exchange for money.

Let $m \in (0, 1)$ denote the fraction of agents with money, i.e., the stock of money in the economy, and let U^i, with $i \in \{0, 1\}$, be the lifetime payoff to an agent who always enters the market when the agent has i units of money at the beginning of a period.[8] These payoffs satisfy the following recursions provided trade is incentive compatible:

$$U^0 = (1-m)\beta U^0 + m\left[\frac{1}{2}\big(-c+\beta U^1\big) + \frac{1}{2}\beta U^0\right]; \tag{4}$$

$$U^1 = m\beta U^1 + (1-m)\left[\frac{1}{2}\big(u+\beta U^0\big) + \frac{1}{2}\beta U^1\right]. \tag{5}$$

The interpretation of (4) and (5) is straightforward. For instance, (4) states that an agent

[8] Clearly, monetary trade is not feasible if $m = 1$.

without money at the beginning of a period trades only if the agent's trading partner has money and the agent is the producer, in which case the agent starts the next period with one unit of money. Recursion (5) has a similar interpretation.

The participation constraints for trade are $U^0 \geq 0$ and $U^1 \geq 0$. The incentive-compatibility constraints for trade are:

$$-c + \beta U^1 \geq \beta U^0; \tag{6}$$

$$u + \beta U^0 \geq \beta U^1. \tag{7}$$

Inequality (6) states that a producer is willing to produce in exchange for money, whereas (7) states that a consumer is willing to give up money in exchange for the special good.

Note that $U^0 \geq 0$ and (6) imply that $U^1 > 0$. Since we can rewrite (4) as

$$U^0 = \frac{-mc + m\beta\big(U^1 - U^0\big)}{2(1-\beta)},$$

we also obtain that (6) implies $U^0 \geq 0$. Thus, (6) implies that both participation constraints are satisfied. Subtracting (4) from (5) and solving the resulting equation for $U^1 - U^0$, we obtain that

$$U^1 - U^0 = \frac{(1-m)u + mc}{2-\beta}. \tag{8}$$

So, (7) holds regardless of β. Thus, monetary trade if feasible if, and only if, (6) holds. The next result follows from (6) and (8) after straightforward algebraic manipulation.

Proposition 2. *Suppose the stock of money is $m \in (0,1)$. Trade is feasible in the monetary economy if, and only if,*

$$\frac{m(1-m)(u-c)}{2} \geq \frac{m(1-\beta)c}{\beta}. \tag{9}$$

Similarly to (3), the left-hand side of (9) is the flow welfare in the monetary economy. Indeed, when the stock of money is m, the fraction of meetings at which trade takes place is $m(1-m)$ and $(u-c)/2$ is the gain from trade in such meetings. The right-hand side of (9) has a different interpretation from the right-hand side of (3), though. Indeed, we know from the discussion leading to Proposition 2 that monetary trade is feasible if, and only if, the agents who acquire money through costly production are compensated for their production effort. So, while in the credit economy all agents with a good label must receive a flow payoff that compensates them for the cost of production, even if they did not engage in production, in the monetary economy only a subset of agents, the fraction m of agents who acquired money through costly production, require such compensation. As we are going to see in Section 5, this fact explains why the government might prefer monetary trade to credit trade even if the latter generates more gains from trade.

4 Government Taxation

In this section, we examine government taxation. We, first consider the credit economy and then consider the monetary economy.

4.1 Credit Economy

In the credit economy, the government chooses for each period t the tax $x_t^C \geq 0$ the agents who enter the market in period t pay to the government; recall that agents pay taxes by producing the general good to the government. Since the government can commit only to one-period ahead taxes, in every period t it sets the period-$(t+1)$ tax to maximize its payoff from period $t+1$ on taking its future behavior as given. We rule out the possibility that agents can play trigger strategies whereby they adjust their entry decisions in response to the government's choice of taxes, in which case they would be able to sustain zero taxes with the threat of moving to autarky.[9] Instead, we focus on equilibria in which the agents enter the market and follow the credit arrangement described in Section 3 provided that their participation and incentive-compatibility constraints for trade are satisfied. This amounts to a restriction to Markovian behavior by the agents and implies that when setting the period-$(t+1)$ tax in period t, the government takes its flow payoffs from period $t+2$ on to be independent of the period-$(t+1)$ tax, as this tax does not affect the agents' participation and

[9]One can rule out trigger strategies of the type just described by assuming that there exists a maximum amount of the general good that agents can produce in any given period and that for a small fraction of agents autarky is sufficiently unattractive that they prefer entering the market even if taxes are the highest possible.

incentive-compatibility constraints for trade from period $t+2$ on, and so do not affect the government's behavior from period $t+1$ on. As the government can only tax the agents if they enter the market and trade, we assume that agents do so in every period when setting up the government's taxation problem.

Let U_t^C be the (expected present-discounted) lifetime payoff from period t on to an agent before the agent pays taxes in period t and V_t^C be the same agent's lifetime payoff after the agent pays taxes in period t. Then

$$U_t^C = -x_t^C + V_t^C \quad \text{and} \quad V_t^C = \frac{\lambda(u-c)}{2} + \beta U_{t+1}^C. \tag{10}$$

Since x_t^C is non-negative for all $t \in \mathbb{Z}$, it follows from (10) that U_t^C is bounded above by U^C for all $t \in \mathbb{Z}$.[10] Intuitively, the agents' lifetime payoff from entering the market cannot be higher than their lifetime payoff in the absence of government taxation. It also follows from (10) that if $G_t^C = x_t^C$ is the government's flow payoff in period t, then

$$G_t^C = \frac{\lambda(u-c)}{2} - U_t^C + \beta U_{t+1}^C. \tag{11}$$

Consider the government's choice of period-$(t+1)$ tax in period t. Since taxation allows the government to transfer utility from the agents to it, and so determine the agents' payoffs, the government can take the payoff U_{t+1}^C as a choice variable. Moreover, as the government takes its flow payoffs from period $t+2$ on as given and independent of the period-$(t+1)$ taxes, it follows that the government can take the payoffs $(U_{t+1+k}^C)_{k\geq 1}$, and in particular the payoff U_{t+2}^C, as given.[11] So, by (11), the government's taxation problem in period t is

$$\begin{array}{rl} \min_{U_{t+1}^C} & U_{t+1}^C \\ \text{s.t.} & \beta U_{t+1}^C \geq c \\ & U_{t+1}^C \geq 0 \\ & U_{t+1}^C \leq U^C \end{array} . \tag{12}$$

The first two constraints in (12) are the constraints for trade affected by the government's

[10] Indeed, (10) implies that $U_t^C \leq \lambda(u-c)/2 + \beta U_{t+1}^C$ for all $t \in \mathbb{Z}$, from which the desired result follows.

[11] Indeed, for all $k \geq 1$, $U_{t+1+k}^C = \sum_{s=1}^{\infty}(-1)^{s-1}\beta^{s-1}\lambda(u-c)/2 - \sum_{s=1}^{\infty}(-1)^{s-1}\beta^{s-1}G_{t+s+k}^C$ by (11).

choice of period-$(t+1)$ tax in period t, namely, the agents' incentive compatibility constraint for trade in period t and the agents' participation constraint for trade in period $t+1$. The last constraint in (12) is the constraint that the agents' payoff cannot be greater than their payoff without government taxation and comes from the fact that the government cannot produce. Clearly, the first constraint in (12) implies the second.

Note that one-period commitment to taxes is crucial for the feasibility of trade in the credit economy. Indeed, if in some period t the government could change the period-t tax after trade took place in period $t-1$, then it would set the tax in period t to make the agents indifferent between staying in the market and moving to autarky in period t. In anticipation of this, agents would have no incentive to produce in period $t-1$, unravelling trade in all periods preceding t.

We now define feasible and optimal policies for the government. Note, by (11), that the sequence $(U_t^C)_{t\in\mathbb{Z}}$ of agent payoffs determines the sequence $(x_t^C)_{t\in\mathbb{Z}}$ of taxes residually as

$$x_t^C = \frac{\lambda(u-c)}{2} - U_{t+1}^C + \beta U_{t+2}^C. \tag{13}$$

Definition 1. *A feasible policy is a sequence* $(U_t^C)_{t\in\mathbb{Z}}$ *with* $U_t^C \leq U^C$ *and* $\beta U_{t+1}^C \geq c$ *for all* $t \in \mathbb{Z}$*. An optimal policy is a feasible policy* $(U_t^C)_{t\in\mathbb{Z}}$ *such that* $U_{t+1}^C \leq \widetilde{U}_{t+1}^C$ *for all* $t \in \mathbb{Z}$ *for any other feasible policy* $(\widetilde{U}_t^C)_{t\in\mathbb{Z}}$*.*

The next result shows that taxation in the credit economy is feasible—i.e., the set of feasible policies for the government is non-empty—if, and only if, trade in the credit economy is feasible and describes the optimal policy for the government when this is the case.

Proposition 3. *Taxation in the credit economy is feasible if, and only if, trade is feasible. The optimal policy for the government when trade is feasible is*

$$x_t^C \equiv x^C = \frac{\lambda(u-c)}{2} - \frac{(1-\beta)c}{\beta}. \tag{14}$$

Equation (14) shows that as long as trade is feasible in the credit economy, the optimal flow payoff to the government is the flow welfare in the economy net of the smallest flow payoff the agents must receive if credit is to be feasible, which is non-negative given that trade is feasible. Since a credit arrangement in which agents with a bad label are not permanently excluded from trade requires agents to receive a higher flow payoff for credit to be feasible, it follows that alternative credit arrangements would lower the government's payoff from taxation in the credit economy.

Proof of Proposition 3. Suppose that trade is not feasible. Since $U_t^C \geq c/\beta$ for all $t \in \mathbb{Z}$ is necessary for a policy to be feasible, it follows from Proposition 1 that any feasible policy is such that $U_t^C > \lambda(u-c)/2(1-\beta) = U^C$ for all $t \in \mathbb{Z}$. So, no feasible policy exists. Now suppose that trade is feasible. Note that regardless of U_{t+2}^C, the solution to (12) is bounded below by c/β. Moreover, given that trade is feasible, $U_t^C \equiv c/\beta < U^C$ for all $t \in \mathbb{Z}$. So, $(U_t^C)_{t\in\mathbb{Z}}$ with $U_t^C \equiv c/\beta$ is the optimal policy. □

4.2 Monetary Economy

In the monetary economy, a policy for the government is a stock $m \in (0,1)$ of money and a sequence $((x_t^0, x_t^1))_{t\in\mathbb{Z}}$ such that x_t^i is the amount of the general good an agent with $i \in \{0,1\}$ units of money who enters the market in period t has to produce to the government at the beginning of this period.[12] We refer to $((x_t^0, x_t^1))_{t\in\mathbb{Z}}$ as the government's tax policy.

As in the credit economy, we consider equilibria in which the agents enter the market and follow the monetary arrangement described in Section 3 provided that their participation and incentive-compatibility constraints for trade hold. So, when the government sets the period-$(t+1)$ taxes in period t, it takes its flow payoff from period $t+2$ on as given and independent of the period-$(t+1)$ taxes. Since the government can only tax the agents if they enter the market and trade, we again assume that the agents do so in every period when setting up the government's taxation problem.

Let U_t^i be the lifetime payoff from period t on to an agent before the agent pays taxes in

[12] The assumption that the government cannot let the stock of money change over time is consistent with our focus on long-run taxation. Moreover, since the government would not be worse off if it could vary the stock of money over time, restricting this stock to be time invariant only strengthens our result that fiscal considerations may lead the government to prefer a less efficient trading technology.

period t when the agent has $i \in \{0,1\}$ units of money. Moreover, let V_t^i be the same agent's lifetime payoff after the agent pays taxes in period t. These payoffs satisfy the following system of equations when stock of money in the economy is $m \in (0,1)$:

$$\begin{aligned} U_t^i &= -x_t^i + V_t^i,\ i \in \{0,1\} \\ V_t^0 &= (1-m)\beta U_{t+1}^0 + m\left[\frac{1}{2}\left(-c+\beta U_{t+1}^1\right) + \frac{1}{2}\beta U_{t+1}^0\right] . \\ V_t^1 &= m\beta U_{t+1}^1 + (1-m)\left[\frac{1}{2}\left(u+\beta U_{t+1}^0\right) + \frac{1}{2}\beta U_{t+1}^1\right] \end{aligned} \tag{15}$$

Since x_t^0 and x_t^1 are non-negative for all $t \in \mathbb{Z}$, it follows from (15) that

$$mU_t^0 + (1-m)U_t^0 \leq U^M = \frac{m(1-m)(u-c)}{2(1-\beta)} \tag{16}$$

regardless of t.[13] Indeed, in the monetary economy the agents' *average* lifetime payoff from entering the market cannot be higher than their average lifetime payoff without government taxation. It also follows from (15) that if $G_t^M = mx_t^1 + (1-m)x_t^0$ is the government's flow payoff in period t when the stock of money is m, then

$$G_t^M = \frac{m(1-m)(u-c)}{2} - \left[mU_t^1 + (1-m)U_t^0\right] + \beta\left[mU_{t+1}^1 + (1-m)U_{t+1}^0\right]. \tag{17}$$

We solve for the government's optimal policy in two steps. First, for each $m \in (0,1)$, we determine the optimal tax policy when the stock of money is m provided taxation is feasible. Then, taking the tax policy for each choice of the stock m of money to be the optimal tax policy (provided taxation is feasible), we determine the optimal choice of m.

Fix the stock $m \in (0,1)$ of money and consider the government's tax choice in period t. Analogously to the analysis of government taxation in the credit economy, the government can treat the payoffs U_{t+1}^0 and U_{t+1}^1 as choice variables and take the payoffs U_{t+2}^0 and U_{t+2}^1 as given and independent of U_{t+1}^0 and U_{t+1}^1. So, by (17), the government's taxation problem in

[13]Indeed, (15) implies that $mU_t^1 + (1-m)U_t^0 \leq m(1-m)(u-c)/2 + \beta\left[mU_t^1 + (1-m)U_t^0\right]$ for all $t \in \mathbb{Z}$, from which the desired inequality follows.

period t is

$$\begin{aligned} \min_{U^0_{t+1}, U^1_{t+1}} \quad & mU^1_{t+1} + (1-m)U^0_{t+1} \\ \text{s.t.} \quad & u \geq \beta(U^1_{t+1} - U^0_{t+1}) \geq c \\ & U^0_{t+1} \geq 0, U^1_{t+1} \geq 0 \\ & \frac{m(1-m)(u-c)}{2} - \left[mU^1_{t+1} + (1-m)U^0_{t+1}\right] \\ & \qquad\qquad + \beta\left[mU^1_{t+2} + (1-m)U^0_{t+2}\right] \geq 0 \end{aligned} \quad . \tag{18}$$

The first two sets of constraints in (18) are the agents' constraints for trade affected by the government's choice of period-$(t+1)$ taxes in period t, namely, the incentive-compatibility constraints for trade in period t and the participation constraints for trade in period $t+1$. The last constraint in (18) is the constraint that the government's payoff in period $t+1$ is non-negative, and comes from the fact that the government cannot produce.[14]

We now define feasible and optimal tax policies for the government given a stock of money. Note, by (15), that if the stock of money is m, then the sequence of pairs of agent payoffs $((U^0_t, U^1_t))_{t\in\mathbb{Z}}$ determines the government's tax policy $((x^0_t, x^1_t))_{t\in\mathbb{Z}}$ residually as:

$$\begin{aligned} x^0_t &= -\frac{mc}{2} + \left(1 - \frac{m}{2}\right)\beta U^0_{t+1} + \frac{m}{2}\beta U^1_{t+1} - U^0_t; \\ x^1_t &= \frac{(1-m)u}{2} + \frac{(1-m)}{2}\beta U^0_{t+1} + \frac{(1+m)}{2}\beta U^1_{t+1} - U^1_t. \end{aligned}$$

Definition 2. *Suppose the stock of money is $m \in (0,1)$. The sequence $((U^0_t, U^1_t))_{t\in\mathbb{Z}}$ is a feasible (tax) policy if $mU^1_t + (1-m)U^0_t \leq U^M$ and (U^0_{t+1}, U^1_{t+1}) satisfies the constraints in* (18) *for all $t \in \mathbb{Z}$. A feasible policy $((U^0_t, U^1_t))_{t\in\mathbb{Z}}$ is optimal if $mU^1_t + (1-m)U^0_t \leq m\widetilde{U}^1_t + (1-m)\widetilde{U}^0_t$ for all $t \in \mathbb{Z}$ for any other feasible policy $((\widetilde{U}^0_t, \widetilde{U}^1_t))_{t\in\mathbb{Z}}$.*

Fix the stock $m \in (0,1)$ of money and consider first the case in which trade is not feasible. Since $U^0_t \geq 0$ and $U^1_t \geq c/\beta$ for all $t \in \mathbb{Z}$ is necessary for $((U^0_t, U^1_t))_{t\in\mathbb{Z}}$ to be feasible, it follows that any feasible policy is such that $mU^1_t + (1-m)U^0_t \geq m\beta/c > U^M$ for all $t \in \mathbb{Z}$, where the strict inequality follows from the assumption that trade is not feasible. Thus, no

[14]For the same reason as in the credit economy, one-period commitment to taxes is crucial for the feasibility of trade in the monetary economy.

feasible policy exists. Now consider the case in which trade is feasible. Note that regardless of (U^0_{t+2}, U^1_{t+2}), the solution to (18) is bounded below by mc/β. Moreover, since trade is feasible, $U^0_t \equiv 0$ and $U^1_t \equiv c/\beta$ implies that

$$\frac{m(1-m)(u-c)}{2} - \left[mU^1_t + (1-m)U^0_t\right] + \beta\left[mU^1_{t+1} + (1-m)U^0_{t+1}\right] \geq 0$$

for all $t \in \mathbb{Z}$. So, $((U^0_t, U^1_t))_{t\in\mathbb{Z}}$ with $U^0_t \equiv 0$ and $U^1_t \equiv c/\beta$ is the optimal tax policy. We have thus established the following result; note that $x^1(m)$ is positive if, and only if, trade is feasible when the stock of money is m.

Lemma 1. *Suppose the stock of money is $m \in (0,1)$. Taxation in the monetary economy is feasible if, and only if, trade is feasible. The optimal tax policy for the government when trade is feasible is*

$$x^0_t \equiv 0 \textit{ and } x^1_t \equiv x^1(m) = \frac{(1-m)(u-c)}{2} - \frac{(1-\beta)c}{\beta}.$$

It follows from Lemma 1 that provided trade is feasible, agents without money pay less taxes than agents with money. This does not mean that the former are less heavily taxed than the latter. The opposite happens, actually: the continuation payoff to agents without money is *smaller* than the continuation payoff to agents with money, implying a tax subsidy to the latter (by means of forgone taxes).

We now determine the government's optimal stock of money. By Lemma 1, when this stock is $m \in (0,1)$, the optimal flow payoff to the government is time-invariant and equal to

$$mx^1(m) = \frac{m(1-m)(u-c)}{2} - \frac{m(1-\beta)c}{\beta} \tag{19}$$

provided trade is feasible. This payoff is the flow welfare in the monetary economy net of the smallest average flow payoff the government must provide to the agents in order for monetary trade to be feasible when the stock of money is m. The choice of m that maximizes (19) is

$$m^* = \frac{1}{2} - \frac{(1-\beta)c}{\beta(u-c)} \tag{20}$$

Since the objective function in (19) is strictly concave, we then have the following result.

Proposition 4. *Suppose there exists a stock* $m \in (0,1)$ *of money for which monetary trade is feasible and let* $\overline{m} \in (0,1)$ *be highest such stock of money. The optimal policy for the government is* $m = m^{**}$ *and* $(x_t^0, x_t^1) \equiv (0, x^1(m^{**}))$ *where* $m^{**} = \min\{m^*, \overline{m}\}$.

Note that the government's optimal choice for the stock of money does not maximize gains from trade. Indeed, by reducing the stock of money below its welfare-maximizing value, $1/2$, the government reduces both the gains from trade and the average flow payoff that agents must receive in order for trade to be feasible. On the margin, the loss in gains from trade is second-order while the reduction in the agents' average flow payoff is first-order. Hence, taxation considerations lead the government to sacrifice gains from trade so that the surplus it needs to leave to the agents in order for trade to be feasible is smaller.[15]

Finally, note from Proposition 2 that the feasibility of trade in the monetary economy is equivalent to

$$m \leq 1 - \frac{2(1-\beta)c}{\beta(u-c)} = m^* + \frac{1}{2} - \frac{(1-\beta)c}{\beta(u-c)}.$$

Since, by Proposition 1,

$$\frac{(1-\beta)c}{\beta(u-c)} \leq \frac{1}{2},$$

is necessary for trade to be feasible in the credit economy, we have that if this is the case, then trade is also feasible in the monetary economy provided $m \leq m^*$. We then have the following result.

Corollary 1. *Suppose trade is feasible in the credit economy. The optimal policy for the government in the monetary economy is* $m = m^*$ *and* $(x_t^0, x_t^1) \equiv (0, x^1(m^*))$.

We assumed in our analysis that the government can observe the agents' money holdings and tax them accordingly. If this were not the case, then agents with one unit of money would have an incentive to claim they have zero units of money and reduce their tax to zero. In Appendix A.1, we extend our analysis of taxation in the monetary economy to the case

[15] A similar reasoning in our analysis of the divisible-money case in Appendix B shows that the Friedman rule is suboptimal for the government.

in which the government cannot observe the money holdings of agents and show that if the government taxes money holdings based on the agents' reported money holdings, then it obtains the same payoff as when money holdings are observable.[16]

5 Comparing Credit and Money

In this section, we compare government taxation in the credit and monetary economies. We first show that the government is able to extract more surplus from the agents in the monetary economy than in the credit economy and discuss this result. We then use this result to establish that the government may prefer monetary trade to credit trade even if the latter generates more gains from trade. More generally, we discuss the conditions under which the government prefers monetary trade to credit trade, relating these conditions to efficiency and surplus-extraction considerations.

The relevant case in our analysis is the one in which both credit and monetary trade are feasible and we can meaningfully compare government taxation for these two forms of trade. We know from the previous section that if trade is feasible in the credit economy, then trade is also feasible in the monetary economy when the stock of money is m^*. So, for our purposes, it is necessary and sufficient to ensure that trade is feasible in the credit economy. Let

$$\underline{\lambda} = \frac{2(1-\beta)c}{\beta(u-c)}$$

and note, by Proposition 1, that $\lambda \geq \underline{\lambda}$ is necessary and sufficient for trade to be feasible in the credit economy. Given this, we assume that $\underline{\lambda} < 1$ and restrict attention to the case in which $\lambda \geq \underline{\lambda}$ in what follows.

5.1 Surplus Extraction

Let

$$W^C = \frac{\lambda(u-c)}{2} \text{ and } W^M(m) = \frac{m(1-m)(u-c)}{2}$$

[16] We also show that taxing money holdings when they are observable does not alter the government's optimal flow payoff.

be, respectively, the flow welfare in the credit economy and the flow welfare in the monetary economy when the stock of money is $m \in (0,1)$. It follows from Proposition **??** that

$$L^C = W^C - x^C = \frac{(1-\beta)c}{\beta}$$

is the (flow) loss the government incurs in the credit economy when optimally taxing the agents. Note that L^C is the smallest flow payoff the agents must receive in order for trade to be feasible in the credit economy. On the other hand, it follows from Corollary 1 that

$$L^M = W^M(m^*) - m^* x^1(m^*) = \frac{m^*(1-\beta)c}{\beta}$$

is the loss the government incurs in the monetary economy when optimally taxing the agents. Note that L^M is the smallest average payoff flow payoff the agents must receive in order for trade to be feasible in the monetary economy when the stock of money is m^*.

It is immediate to see that

$$L^M > L^C.$$

Thus, the loss in surplus the government incurs when optimally taxing the agents in the monetary economy is smaller than the same loss in the credit economy. To put it differently, the government can extract surplus from the agents more efficiently in the monetary economy than in the credit economy.

To understand why surplus extraction is more efficient in the monetary economy, note that in the credit economy all agents with a good label must be provided with an incentive to produce—by means of a higher continuation payoff, and thus lower taxes, should they keep the good label—even if only a fraction of them engage in production. On the other hand, in the monetary economy only the agents with no money holdings must be provided with an incentive to produce, by means of a higher continuation payoff should they acquire one unit of money. To summarize, by being unable to distinguish between consumers and producers in the credit economy, because of the decorrelation between consumption and production afforded by credit, the government ends up leaving more surplus in the agents' hand than it does in the monetary economy.

A couple of remarks are in order. First, as we show in Appendix A.1, the result that the government can extract surplus more efficiently in the monetary economy is not driven by our assumption that money holdings are observable: the government can extract the same surplus from the agents when money holdings are unobservable if it taxes agents according to reported money holdings.[17] Second, the fact that the government has a richer set of tax instruments in the monetary economy—taxes conditional on money holdings—also does not explain why surplus extraction is more efficient in the monetary economy. In Appendix A.2, we consider government taxation in the monetary economy when the government is constrained to use the same tax regardless of an agent's money holdings. We show that as long as gains from trade are not too high, the government can still extract surplus more efficiently in the monetary economy. Intuitively, uniform taxation leads to a loss in the government's ability to extract surplus from the agents and this loss increases with gains from trade. Nevertheless, because money holdings correlate with production decisions, more efficient surplus extraction is still possible: despite uniform taxation, the continuation payoffs of agents with money are still higher than the continuation payoffs of agents without money.[18]

5.2 Payoffs from Taxation

In what follows, we restrict attention to the region of parameters in which credit trade is feasible, since it immediately implies that monetary trade is feasible, and we can meaningfully compare government taxation across these modes of trade. Precisely, we assume that

$$\text{A1} : 1 \geq \lambda \geq \underline{\lambda} \equiv \frac{1-\beta}{\beta}\frac{2c}{u-c}.$$

[17]Also note that unlike in the monetary economy, where by appropriately setting a menu of taxes conditional on reported money holdings the government can elicit the agents' money holdings, in the credit economy the government cannot elicit the agents' status as consumers or producers in a monitored meeting. Indeed, since an agent's status in a monitored meeting is uninformative of the agent's status in future monitored meetings, the government has no leverage to induce truthful revelation by the agents. We present a more detailed discussion of this issue in Appendix B.2, when we discuss our model of bilateral credit.

[18]Our analysis of bilateral credit in Appendix B.2 reinforces this point. As it turn out, in the economy with bilateral credit, the government has a richer set of instruments to tax the agents. Nevertheless, the government is still able to extract surplus more efficiently in the monetary economy.

In the presence of credit trade, the government's flow payoff is then

$$G^C = \frac{\lambda(u-c)}{2} - \frac{(1-\beta)c}{\beta},$$

while in the presence of monetary trade, its flow payoff is

$$G^M = \frac{1-\underline{\lambda}^2}{4}\frac{(u-c)}{2} - \frac{1-\underline{\lambda}}{2}\frac{(1-\beta)c}{\beta},$$

where we used $m^* = \frac{1-\underline{\lambda}}{2}$.

In the credit economy the flow welfare is strictly higher than the flow welfare in the monetary economy. Everything else constant, a higher welfare creates a larger tax base to the government, which favors credit trade over monetary trade. However, in a credit economy, all agents have a good label and each one of them must be compensated with a flow payoff $\frac{(1-\beta)c}{\beta}$. In a monetary economy, instead, only the agents with money require such compensation, since they are the only agents that may have produced in the previous period. This allows to save on the aggregate amount of resources that needs to be kept by the agents to ensure their participation in trade, which favors monetary trade over credit trade. We can now state our main result.

Proposition 5. *Let* $\lambda_1 = \left(\frac{1+\underline{\lambda}}{2}\right)^2$ *and* $\lambda_0 = \frac{1-\underline{\lambda}^2}{4}$.

(i) if $\lambda \in [\underline{\lambda}, \lambda_0]$*, monetary trade is more efficient than credit trade and the government prefers monetary trade over credit trade;*

(ii) if $\lambda \in (\lambda_0, \lambda_1]$*,monetary trade is less efficient than credit trade and the government prefers monetary trade over credit trade*

(iii) if $\lambda > \lambda_1$*, credit trade is more efficient than monetary trade and the government prefers credit trade over monetary trade;*

It follows from Proposition 5 that a necessary condition for credit trade to be more desirable for the government than monetary trade is that it is more efficient. In particular, if $\lambda < \lambda_0$, credit trade is less efficient and the government prefers monetary trade. If we think of λ as capturing the extent to which exchange happens between informationally connected agents, then Proposition 5 (i) is consistent with the view that money is essential because it increases surplus creation, by allowing trade between strangers. However, even when $\lambda > \lambda_0$ and credit trade is more efficient, it can still be the case that the government prefers monetary trade. Thus, Proposition 5 (ii) is consistent the view that money is essential not because it increases surplus creation but because it increases surplus extraction. Finally, Proposition 5 (iii) states that money is not essential if credit trade is markedly more efficient than monetary trade.

6 Relationship to the Literature

Money and credit are two fundamentally different ways to organize trade. Under a monetary arrangement transactions are settled on the spot (*quid pro quo*) by the transfer of a physical and impersonal object—fiat or commodity money—, and trade requires the buyer to initially hold money *and* the seller to have incentives to acquire it. Under a credit arrangement transactions are settled by a form of promise—either bilateral or multilateral—potentially subject to default, and the critical issue is traders' incentives to maintain their personal creditworthiness.

A key insight of our contribution is that this difference as trading arrangements has fiscal implications, and as we show gives money a comparative advantage over credit from a rent-extraction point-of-view. This insight offers a novel perspective on several classical questions in monetary theory, in particular on the nature and origins of money, and on its connection with the state and with taxation.

Barter and (the origin of) money.—-The search for the origin of money is a concern for economists since Smith (1776). Following Smith, Jevons (1875) and Menger (1892) argued that money gradually emerged as a market solution to the "inconveniences of barter", e.g. lack of divisibility of goods and the double-coincidence-of-wants problem. The subsequent literature has added the difficulty to ascertain the quality of goods to the cost of barter (Alchian, 1977), and developed formal frameworks in which money has value as a means-of-exchange in environments where the difficulty of barter are explicitly modelled (Ostroy and

Starr (1974), Kiyotaki and Wright (1989), Williamson and Wright (1994), Trejos and Wright (1995), Barnerjee and Maskin (1996)). Contemporary evidence gathered in other social sciences shows that this comparison between money and barter has limited relevance for the actual evolution of money (see Section 7 below). From a payment system theory viewpoint, barter shares with money the feature that trade is settled on the spot in anonymous transactions *but as shown by Kiyotaki and Wright 1989, with more complex trades to complete*. Our contribution provides a theory of the origin in which the counterfactual is credit, a very different way to organize trade.

Money vs credit.—-We build on the literature that emphasizes the communication and record-keeping aspect of money vs credit. A common thread in that literature, culminating in the contribution by Kocherlakota (1998), is that money is a limited form of memory of past transactions.[19] In particular, money is necessary for efficiency only when there is imperfect monitoring, as happens when trading with strangers (Townsend, 1989). Our analysis is consistent with this view, since a decrease in the coverage ratio λ favors money over credit. By adding a fiscal motive, we uncover a rent extraction advantage of money : even when credit dominates in terms of total surplus, money is helpful to implement allocations that are not attainable with the credit arrangement. This is consistent with the essentiality view emphasized by Wallace (2001). Recent contributions argue that the anonymity of cash can be valuable when privacy is important (see Kahn et al. (2005), and more recently Garratt and van Oordt (2021)). We extend this literature by exploring a different implication of an anonymous payment system: the scope for taxation is greater than under credit.

Money and the state.—There is a long tradition that views money as a creation of law, and its general acceptability as a consequence of acceptance by the state in tax payments (Knapp, 1905; Lerner, 1947).[20] Formal analysis of this argument include contributions such as Aiyagari and Wallace (1997) and Li and Wright (1998), who show how the exogenous

[19]See Ostroy (1973) for an early appearance of this notion, and Wallace (2011) for an informed presentation of this line of research.

[20]This view was also endorsed by Smith (1776). See the following oft cited quote : "A prince, who should enact that a certain proportion of his taxes be paid in a paper money of a certain kind, might thereby give a certain value to this paper money."

transaction policy of government agents can coordinate the economy on monetary rather than barter trade. Closer to our paper, Goldberg (2012) constructs a model in which a government can promote its currency by imposing that taxes be paid with it and extract revenues from seigniorage. In our model also, the fiscal authority takes central stage, but our argument is different. Seigniorage plays no role in our theory. Indeed, in our model taxes are paid in kind,and the government derives no direct revenues from the issuance of money. Instead, our point is on how the ability to tax is constrained by the trading arrangement. If there is a potentially more efficient way to organize trade—e.g. credit—the fact that the ruler maximizes his fiscal revenues is not sufficient *per se* to explain the domination of money. Why not choosing the efficient trading technology and extracting all surplus? Our contribution here is to provide an alternative rationale for the observed correlation between the state and the emergence of money, through the rent extraction advantage of money over credit.

Money and taxation.—There is also a large macroeconomic literature on the interactions between monetary and fiscal policies. This literature has naturally investigated the role of seigniorage as a source of government revenue (see Friedman (1971); Fischer (1982); Kehoe and Nicolini (2021), among others). More recently, building on the initial insight in Sargent and Wallace (1981), a lot of work has been devoted to analyse the constraints that fiscal and monetary policies exert on each other. In particular, the fiscal theory of the price level develops the idea that the price level and inflation are ultimately driven by fiscal factors (see Leeper (1991); Woodford (1995) for seminal papers). This literature is not concerned with how trade takes place, and focuses on a separate set of issues. We provide a theory of the fiscal origin of money, and show that the trading mechanism exerts a constraint on the fiscal capacity of the state.

7 Relationship to History

TO BE WRITTEN

8 Final Remarks

The idea that the government's revenue from taxation increases with the surplus created by economic activity is fairly intuitive, and it suggests that, everything else held constant, the government favors trading arrangements that create the largest surplus. We show that the ability of the government to extract a larger fraction of the surplus is strictly higher in a monetary economy than in a credit economy. In the monetary economy, there is a link between past production and current money holdings, and the government can use this link to compensate those that produced in order to incentivize their participation in trade. In contrast, the credit economy decorrelates production and consumption, which enlarges the number of exchanges that can be made but reduces the ability of the government to identify those that actually produced. The search for a better alignment between surplus creation and surplus extraction offers a rationale for the emergence of money that is broadly consistent with the historical and the anthropological evidence, in contrast to the efficiency view that sees money as the natural development out of the inconveniences of barter.

Our message is robust to alternative modeling assumptions, that we explore in the Appendix. First, we show that our result does not hinge on the fact that in the monetary economy the government can tax differently agents with money and agents without money, while in the credit economy there is a uniform taxation. We show that our message is preserved if we impose uniform taxation in the monetary economy. We also show that the observability of money holdings that was part of the monetary arrangement is not important and the same results carry through if money holdings are not observable. In turn, we consider a version of our economy with divisible goods and divisible money based on Lagos and Wright (2005) and show that our results are preserved. Finally, we also show that our results are preserved if we consider a more standard model of bilateral credit with creditors and debtors.

In summary, we have shown that the only reason credit may dominate money from the government's perspective is because it creates more surplus. If the difference between the surplus produced under each technology reduces, say because the monitoring technology worsens or because money becomes a more efficient medium of exchange, the government may prefer to tax under the monetary arrangement even though the credit arrangement is better from the society's point of view. This suggests a different view on the essentiality of money, one that is not driven by welfare considerations but by money's efficiency in transferring surplus from the society to the government.

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A Appendix: Robustness

Here, we discuss several extensions of our model. We begin by showing that in the monetary economy the optimal flow payoff to the government does not change if the government cannot observe the agents' money holdings. When then show that our main conclusions remain the same if taxation in the monetary economy is uniform. Following that, we consider a model of bilateral credit and show that our conclusions also remain the same. Finally, we extend our model of money to allow for divisible money and no upper bound on money holdings and show that this does not change the substance of our conclusions.

A.1 Taxation with Unobservable Money Holdings

We first consider government taxation in the monetary economy when the government does not observe the agents' money holdings. This introduces an additional constraint in the government's problem since now agents with money can choose to hide their money holdings if this entails lower taxes; an agent without money cannot claim to have money since the government can ask this agent to prove that this is indeed the case.

With unobservable money holdings, a policy for the government is the stock $m \in (0, 1)$ of money and, for each $t \in \mathbb{Z}$, a menu $(q_t^0, x_t^0, q_t^1, x_t^1)$ where: (*i*) q_t^i is the probability that an agent who claims to have $i \in \{0, 1\}$ units of money in period t enters the market with one unit of money; and (*ii*) x_t^i is the tax that such an agent pays. It is without loss to assume that agents with one unit of money truthfully reveal their money holdings since an option for the government is to set $q_t^0 = 0$, $q_t^1 = 1$, and $x_t^1 = x_t^0$ for all t. Given that the stock of money is constant over time, it must be that $mq_t^1 + (1-m)q_t^0 = m$ for all $t \in \mathbb{Z}$, so that in every period the outflow of money equals the inflow.

As in the case of observable money holdings, we first solve for the optimal tax policy for each choice of the stock m of money and then determine the optimal choice of m. For each $t \in \mathbb{Z}$ and $i \in \{0, 1\}$, let U_t^i and V_t^i be the same payoffs as in the case of observable money holdings assuming that agents truthfully reveal their money holdings. These payoffs satisfy the following system of equation when the stock of money is $m \in (0,1)$:

$$\begin{aligned} U_t^0 &= -x_t^0 + (1-q_t^0)V_t^0 + q_t^0 V_t^1 \\ U_t^1 &= -x_t^1 + q_t^1 V_t^1 + (1-q_t^1)V_t^0 \\ V_t^0 &= (1-m)\beta U_{t+1}^0 + m\left[\frac{1}{2}\left(-c+\beta U_{t+1}^1\right) + \frac{1}{2}\beta U_{t+1}^0\right] \\ V_t^1 &= m\beta U_{t+1}^1 + (1-m)\left[\frac{1}{2}\left(u+\beta U_{t+1}^0\right) + \frac{1}{2}\beta U_{t+1}^1\right] \end{aligned} . \tag{A.1}$$

Now let $G_t^M = G_t^M(m) = mx_t^1 + (1-m)x_t^0$ be the government's flow payoff in period t under truthful revelation when the stock of money is m. Since $mq_t^1 + (1-m)q_t^0 = m$, and thus $(1-m)(1-q_t^0) + m(1-q_t^1) = 1-m$, it follows from (A.1) that

$$G_t^M = \frac{m(1-m)(u-c)}{2} - \left[mU_t^1 + (1-m)U_t^0\right] + \beta\left[mU_{t+1}^1 + (1-m)U_{t+1}^0\right].$$

Fix the stock $m \in (0,1)$ of money and consider the government's taxation problem in period $t-1$. The unit upper bound on money holdings implies that an agent with money in period t has an incentive to truthfully reveal money holdings if

$$U_t^1 \geq -x_t^0 + V_t^1 = U_t^0 + (1-q_t^0)(V_t^1 - V_t^0).$$

Indeed, by claiming to have no money, the agent pays the tax x_t^0 and ensures entry in the market with one unit of money. So, the government's taxation problem in period $t-1$ is

$$\begin{aligned} \min_{U_t^0, U_t^1, q_t^0, q_t^1} \quad & mU_t^1 + (1-m)U_t^0 \\ \text{s.t} \quad & u \geq \beta(U_t^1 - U_t^0) \geq c \\ & U_t^0 \geq 0, U_t^1 \geq 0 \\ & U_t^1 \geq U_t^0 + (1-q_t^0)(V_t^1 - V_t^0) \\ & mq_t^1 + (1-m)q_t^0 = m \end{aligned} . \tag{A.2}$$

If we ignore the last two constraints in (A.2), then the solution to this problem $U_t^0 = 0$ and $U_t^1 = c/\beta$. We claim that if $U_{t+1}^0 = 0$ and $U_{t+1}^1 = c/\beta$, then $U_t^0 = 0$ and $U_t^1 = c/\beta$ is still the solution to (A.2), so that it is optimal for the government to set $U_t^0 \equiv 0$ and $U_t^1 \equiv c/\beta$.

Indeed, when $U^0_{t+1} = 0$ and $U^1_{t+1} = c/\beta$, truth-telling becomes

$$U^1_t \geq U^0_t + (1 - q^0_t)\left[c + \frac{(1-m)(u-c)}{2}\right].$$

This constraint is satisfied when $U^0_t = 0$ and $U^1_t = c/\beta$ if, and only if,

$$q^0_t \geq \underline{q}^0(m) = \frac{2c + (1-m)(u-c) - 2c/\beta}{2c + (1-m)(u-c)}.$$

By setting $q^0_t = \underline{q}^0(m)$ and $q^1_t = \overline{q}^1(m) = 1 - (1-m)\underline{q}^0(m)/m$, we ensure that the two additional constraints in (A.2) are satisfied, thus establishing the desired result.[21]

So, regardless of the stock m of money, the government can overcome the additional constraint imposed by the non-observability of money holdings and obtain the same flow payoff that it obtains when money holdings are observable.[22] This, in turn, implies that the optimal stock of money is m^* given by (20) and that the optimal flow payoff to the government is still given by Proposition 4. To conclude this part, note that the above argument also makes clear that when money holdings are observable, the additional tax instrument does not allow the government to extract more surplus from the agents than it can extract when it only uses taxation of the general good as a tax instrument.

A.2 Uniform Taxation in the Monetary Economy

We now consider the case of uniform taxation in the monetary economy. Suppose that the government is constrained to choose $x^1_t = x^0_t = x_t$ in every period t. Since $U^i_t = -x_t + V^i_t$, it follows that for each choice of the stock $m \in (0, 1)$ of money, the government's problem in period $t - 1$ is

$$\begin{aligned} \max\nolimits_{x_t} \quad & x_t \\ \text{s.t.} \quad & u \geq \beta(V^1_t - V^0_t) \geq c \ , \\ & V^0_t \geq x_t, V^1_t \geq x_t \end{aligned} \tag{A.3}$$

where the payoffs V^0_t and V^1_t do not depend on the government's choice of tax in period $t-1$.

[21] Note that $\underline{q}^0(m) \geq 0$, and so $\overline{q}^1(m) \leq 1$, only if monetary trade is feasible when the stock of money is m.

[22] Note that $x^1_t < 0$ and $x^0_t > 0$ when $q^0_t \geq \underline{q}^0(m^*)$ and $q^1_t \leq \overline{q}^1(m^*)$. So, optimal taxation with unobservable money holdings involves redistribution of general goods and money.

In order to solve (A.3), first note that

$$V_t^1 - V_t^0 = \frac{(1-m)u + mc}{2} + \frac{\beta}{2}(U_{t+1}^1 - U_{t+1}^0).$$

So, $\beta(U_{t+1}^1 - U_{t+1}^0) \leq u$ implies that $\beta(V_t^1 - V_t^0) \leq u$ and $\beta(U_{t+1}^1 - U_{t+1}^0) \geq c$ implies that $\beta(V_t^1 - V_t^0) \geq c$. Therefore, (A.3) has a solution if, and only if, monetary trade is feasible without government taxation when the stock of money is m. Since $V_t^1 > V_t^0$, the solution to (A.3) is $x_t = V_t^0$, which is equivalent to $U_t^0 = 0$. Now observe that if $U_t^0 = 0$, then

$$x_t = V_t^0 = -\frac{mc}{2} + \frac{\beta m}{2} U_{t+1}^1$$

for all t by (15). Given that $U_t^0 = 0$ for all t also implies that

$$U_t^1 = U_t^1 - U_t^0 = V_t^1 - V_t^0 = \frac{(1-m)u + mc}{2} + \frac{\beta}{2} U_{t+1}^1,$$

where the second equality follows from uniform taxation, it follows that

$$U_t^1 = \frac{(1-m)u + mc}{2} \sum_{s=0}^{\infty} \left(\frac{\beta}{2}\right)^s = \frac{(1-m)u + mc}{2-\beta}$$

for all t. We can then conclude that the solution to (A.3) is $x_t = x(m)$, where

$$x(m) = -\frac{mc}{2} + \frac{\beta m}{2} \frac{(1-m)u + mc}{2-\beta} = \frac{\beta}{2-\beta}\left[\frac{m(1-m)(u-c)}{2} - \frac{(1-\beta)mc}{\beta}\right].$$

It follows from the expression for $x(m)$ that the government's optimal choice of the stock of money is the same choice m^* it makes when not restricted to uniform taxation. Note that $x(m^*)$ is positive only if monetary trade is feasible when the stock of money is m^*. We have then established the following result.

Proposition 6. *Suppose that taxation in the monetary economy is restricted to be uniform. The optimal flow payoff to the government is the same in every period and equal to*

$$G^{UM} = \max\left\{0, \frac{\beta}{2-\beta}\left[\frac{m^*(1-m^*)(u-c)}{2} - \frac{(1-\beta)m^*c}{\beta}\right]\right\}.$$

This payoff is positive only if monetary trade is feasible when the stock of money is m^*.

Since $\beta/(2-\beta) < 1$, it follows that $G^{UM} \leq G^{M}$ with $G^{UM} < G^{M}$ if the government can extract surplus from the agents when the stock of money is m^*. So, restricting the government to use uniform taxes in the monetary economy reduces its ability to extract surplus from the agents. The government can still extract the agents' surplus more efficiently than in the credit economy, though. This is so because agents without money only need to be compensated with probability m for money to be feasible when its stock is m, while in the credit economy all agents with a good label need to be compensated for credit to be feasible. To see why, consider the case in which the surplus from trade is the same in both the credit and monetary economies:

$$\frac{m^*(1-m^*)(u-c)}{2} = \frac{\lambda(u-c)}{2}. \tag{A.4}$$

Using (A.4), we have that $G^{C} < G^{UM}$ if, and only if,

$$\frac{c}{m^*} > \beta\frac{(1-m^*)u + m^*c}{2-\beta}.$$

When $\beta \approx 1$, the above inequality becomes $u < 3c$.[23] Thus, as long as gains from trade are not too high, the government can extract surplus more efficiently in the monetary economy than in the credit economy even if taxation is uniform.

B Appendix: Extensions

B.1 Autarky and State Capacity

B.2 Bilateral Credit

Next, we extend our analysis to a model of bilateral credit. The physical environment is the same as in Section 2. Differently from the credit economy considered in the main text, two agents with a good label who participate in a monitored meeting now have the option of forming a credit relationship. If they do, they stay together for two periods and a random draw determines the agent who produces in the first period (the creditor) and the agent who produces in the second period (the debtor). Credit relationships and production decisions are

[23]Note that since $u > c$, Proposition 2 implies that money is feasible if $\beta \approx 1$.

voluntary. As in credit economy considered in the main text, agents who fail to repay their debt, i.e., agents who fail to produce in the second period of a relationship acquire a bad label and are permanently excluded from trade. In what follows, in order to distinguish it from the bilateral-credit economy we consider here, we refer to the credit economy in the main text as the risk-sharing economy.

We first discuss the feasibility of bilateral credit, then discuss government taxation, and finally compare the government's payoffs in the bilateral-credit, risk-sharing, and monetary economies. While there are some differences between the risk-sharing and the bilateral-credit economies, the message remains the same. Namely, even though bilateral credit can be more efficient than monetary trade, the government's ability to extract surplus from the agents in the bilateral-credit economy is smaller than in the monetary economy, leading to the same conclusions as in the main text.

Feasibility

An agent can be in three states in the bilateral-credit economy: (*i*) state 0 if the agent is not in a credit relationship; (*ii*) state c if the agent is a creditor; and (*iii*) state d if the agent is a debtor. Let U^τ be the lifetime payoff to an agent who always enters the market when the agent's state at the beginning of a period is $\tau \in \{0, c, d\}$. Then:

$$U^0 = \lambda \left[\frac{1}{2} \left(u + \beta U^d \right) + \frac{1}{2} \left(-c + \beta U^c \right) \right] + (1 - \lambda) \beta U^0; \tag{B.5}$$

$$U^c = u + \beta U^0; \tag{B.6}$$

$$U^d = -c + \beta U^0. \tag{B.7}$$

As in the risk-sharing economy, $\lambda > 0$ is the probability that two agents in the market participate in a monitored meeting; creditors and debtors do not participate in market meetings, and so only agents in state 0 can meet in the market.

The participation constraints for bilateral credit are $U^\tau \geq 0$ for all $\tau \in \{0, c, d\}$. The incentive compatibility constraints are:

$$-c + \beta U^c \geq \beta U^0; \tag{B.8}$$

$$u + \beta U^d \geq \beta U^0; \tag{B.9}$$

$$-c + \beta U^0 \geq 0. \tag{B.10}$$

Constraints (B.8) and (B.9) ensure that agents find it optimal to start a credit relationship as creditor and debtor, respectively, while constraint (B.10) ensures that debtors find it optimal to repay their debts.

Since (B.10) implies that $U^0 > 0$, it follows from (B.8) that U^c is positive as well. Note that (B.10) also implies that $U^d = -c + \beta U^0$ is positive. So, we can ignore participation constraints when considering the feasibility of bilateral credit. Moreover, it follows from (B.6) and (B.7) that (B.8) is sufficient for (B.9). Intuitively, a debtor gets to consume first and produce later, and so has a greater incentive to form a credit relationship. Thus, (B.8) and (B.10) are necessary and sufficient for bilateral credit to be feasible without government taxation. We have the following result.

Proposition 7. *Bilateral credit is feasible without government taxation if, and only if*

$$\frac{(1+\beta)\lambda}{1+\beta\lambda}\frac{u-c}{2} \geq \frac{(1-\beta)c}{\beta}. \tag{B.11}$$

Proof. Substituting (B.6) and (B.7) into (B.5) and solving the resulting equation for U^0, we obtain that

$$U^0 = \frac{(1+\beta)\lambda}{(1-\beta)(1+\beta\lambda)}\frac{u-c}{2}.$$

Now observe from (B.6) and (B.7) that we can rewrite (B.8) as

$$\beta u - c \geq \beta(1-\beta)U^0.$$

So, a necessary and sufficient condition for bilateral credit to be feasible is that

$$u - \frac{c}{\beta} \geq \frac{(1+\beta)\lambda}{1+\beta\lambda}\frac{u-c}{2} \geq \frac{(1-\beta)c}{\beta}. \tag{B.12}$$

We claim that the second inequality in (B.12) implies the first. Indeed, as $(1+\beta)\lambda/(1+\beta\lambda)$ is bounded above by one, a sufficient condition for the first inequality in (B.12) is that $\beta \geq \beta^* := 2c/(u+c)$. Now note, again since $(1+\beta)\lambda/(1+\beta\lambda)$ is bounded above by one, that a necessary condition for the second inequality in (B.12) is $\beta \geq \beta^{**} := 2c/[\rho u + (2-\rho)c]$. The desired result follows from the fact that $\beta^{**} > \beta^*$. $\square$

Given that $(1+\beta)/(1+\beta\lambda) \geq 1$, the region of the parameter space in which bilateral credit is feasible includes the region of the parameter space in which risk sharing is feasible and is strictly larger if $\lambda < 1$. The intuition for this result is the following. When $\lambda = 1$, risk sharing and bilateral credit are equally efficient, and thus equally attractive to agents. On the other hand, when $\lambda < 1$, bilateral credit is more efficient than risk sharing, and so more attractive to agents. Indeed, by forming a credit relationship, agents ensure that they can trade for two periods, which effectively increases the share of monitored meetings. Moreover, there exists no credit risk, as a consumer in the first period of a credit relationship is by assumption a producer in the second period.[24] Finally, repayment incentives for agents are the same in the bilateral-credit and risk-sharing economies. So, holding all else constant, the incentive of agents to trade under bilateral credit is never smaller than their incentive to trade under risk sharing, and is greater when $\lambda < 1$.[25]

Government Taxation

A policy for the government is, for each $t \in \mathbb{Z}$, the transfer x_t^τ an agent in state $\tau \in \{0, c, d\}$ who enters the market in period t has to make to the government at beginning of the period. As in the main text, we consider equilibria in which the agents enter the market and follow the credit arrangement described above provided that their participation and incentive-compatibility constraints for trade are satisfied. So, as before, when the government sets the

[24]We can introduce credit risk in our model of bilateral credit by assuming that debtors might not be able to repay their debts since they may once again be consumers in the second period of a credit relationship.

[25]Note that unlike in the risk-sharing economy, the term on the left-hand side of (B.11) is not the flow welfare in the economy with bilateral credit. Indeed, this term is the expected flow payoff to the agents who are not in a credit relationship, which is smaller than flow welfare as the latter also takes into account the higher expected flow payoff to agents who are in a credit relationship.

period-t taxes in period $t-1$, it takes its flow payoff from period $t+1$ on as given and independent of the period-t taxes. Also as before, we can assume that in every period the agents have an incentive to enter the market and trade.

Let U_t^τ be the lifetime payoff from period t on to an agent before the agent pays taxes in period t when the agent is in state τ. Moreover, let V_t^τ be the same agent's lifetime payoff after the agent pays taxes in period t. Then:

$$\begin{aligned} U_t^\tau &= -x_t^\tau + V_t^\tau,\ \tau \in \{0, c, d\} \\ V_t^0 &= \lambda \left[\frac{1}{2}\left(u + \beta U_{t+1}^d\right) + \frac{1}{2}\left(-c + \beta U_{t+1}^c\right)\right] + (1-\lambda)\beta U_{t+1}^0 \\ V_t^d &= -c + \beta U_{t+1}^0 \\ V_t^c &= u + \beta U_{t+1}^0 \end{aligned} . \tag{B.13}$$

Now let γ_t be the mass of agents in a credit relationship in period t and G_t^{BC} and W_t^{BC} be, respectively, the flow payoff to the government and the flow welfare in period t. Then,

$$G_t^{BC} = (1-\gamma_t)x_t^0 + \frac{\gamma_t}{2}x_t^c + \frac{\gamma_t}{2}x_t^d \text{ and } W_t^{BC} = [\gamma_t + (1-\gamma_t)\lambda]\,\frac{u-c}{2}.$$

Since $\gamma_{t+1} = (1-\gamma_t)\lambda$, it follows from (B.13) that

$$(1-\gamma_t)U_t^0 + \frac{\gamma_t}{2}U_t^c + \frac{\gamma_t}{2}U_t^d = -G_t^{BC} + W_t^{BC} + \beta\left[(1-\gamma_{t+1})U_{t+1}^0 + \frac{\gamma_{t+1}}{2}U_{t+1}^d + \frac{\gamma_{t+1}}{2}U_{t+1}^c\right].$$

Solving for G_t^{BC}, we obtain that $G_t^{BC} = W_t^{BC} - L_t^{BC}$, where

$$L_t^{BC} = (1-\gamma_t)U_t^0 + \frac{\gamma_t}{2}U_t^c + \frac{\gamma_t}{2}U_t^d - \beta\left[(1-\gamma_{t+1})U_{t+1}^0 + \frac{\gamma_{t+1}}{2}U_{t+1}^c + \frac{\gamma_{t+1}}{2}U_{t+1}^d\right].$$

Consider now the government's problem in period $t-1$. For reasons that we discuss below, assume that $\lambda < 1$. As in the main text, the government can take the payoffs U_t^0, U_t^c, and U_t^d as choice variables and the payoffs U_{t+1}^0, U_{t+1}^c, and U_{t+1}^d to be independent of the payoff vector (U_t^0, U_t^c, U_t^d). Hence, the government's problem in period $t-1$ is

$$\begin{aligned} \min_{U_t^0, U_t^c, U_t^d} \quad & (1-\gamma_t)U_t^0 + \frac{\gamma_t}{2}U_t^c + \frac{\gamma_t}{2}U_t^d \\ \text{s.t.} \quad & -c + \beta U_t^c \geq \beta U_t^0 \\ & u + \beta U_t^d \geq \beta U_t^0 \\ & -c + \beta U_t^0 \geq 0 \\ & U_t^0 \geq 0, U_t^c \geq 0, U_t^d \geq 0 \end{aligned} .$$

The incentive-compatibility and participation constraints in the above problem are those affected by the government's choices in period $t-1$, namely, the constraints that: (*i*) agents find it optimal to form credit relationships in period $t-1$; (*ii*) debtors find it optimal to repay their debts in period $t-1$; and (*iii*) agents find it optimal to participate in trade in period t.

The solution to the government's problem is immediate: $U_t^0 = c/\beta$, $U_t^c = 2c/\beta$, and $U_t^d = 0$. Given that $\lambda < 1$, the difference equation $\gamma_{t+1} = (1-\gamma_t)\lambda$ converges to its unique steady state, $\gamma_\infty = \lambda/(1+\lambda)$, no matter the initial fraction of agents in a credit relationship. Thus, since for any period t there are infinitely many periods before it, we have that

$$W_t^{BC} = W^{BC} = \frac{\lambda(u-c)}{1+\lambda}$$

for all t. On the other hand, $\gamma_t \equiv \gamma_\infty$ implies that

$$L_t^{BC} = L^{BC} = \frac{(1-\beta)c}{\beta}$$

for all t. We have thus established the following result.[26]

Proposition 8. *Suppose that $\lambda < 1$. The optimal flow payoff to the government in the bilateral-credit economy is time invariant and equal to*

$$G^{BC} = \max\left\{0, \frac{\lambda(u-c)}{1+\lambda} - \frac{(1-\beta)c}{\beta}\right\}.$$

[26]When $\lambda = 1$, it follows that $\gamma_{t+1} = 1 - \gamma_t$ for all $t \in \mathbb{Z}$. So, unless $\gamma_t = 1/2$ for some t, the fraction γ_t oscillates over time, never converging to its steady-state value. Nevertheless, $W_t^{BC} = \lambda(u-c)/(1+\lambda)$ and $L_t^{BC} = (1-\beta)c/\beta$ for all t, implying that the same results hold when $\lambda = 1$.

Payoff Comparisons

We conclude this part by comparing the government's optimal payoff in the bilateral-credit economy first with the government's optimal payoff in the risk-sharing economy, and then with the government's optimal payoff in the monetary economy.

Regarding the comparison with the risk-sharing economy, first note that $W^{BC} > W^C$ for all $\lambda < 1$; the reasons for this were discussed after the proof of Proposition 7. Now note that $L^{BC} = L^C$. Indeed, in the bilateral-credit economy, the government cannot distinguish agents who did not participate in a credit relationship from agents who just finished such a relationship. As the latter group includes debtors, who must receive flow payoff c/β if they are to repay their debts, the government has to give the same flow payoff to agents who did not participate in a credit relationship. The same holds in the risk-sharing economy. However, unlike in the risk-sharing economy, the government is now able distinguish between debtors and creditors. To the former, the government only needs to provide a flow payoff of zero, as they are willing to form credit relationships as debtors with only the promise of future participation in the market. To the latter, the government must provide a flow payoff c/β in addition to the flow payoff c/β they secure if they refuse to form a credit relationship. Given that at any point in time there exists an equal mass of creditors and debtors, the average total compensation given to agents that participate in credit relationships is c/β, the same given to agents who did not participate in such relationships. Together, the facts that $W^{BC} > W^C$ and $L^{BC} = L^C$ imply that the government never obtains a lower payoff with bilateral credit than with risk sharing.

We now compare the government's optimal payoff in the bilateral-credit economy with the government's optimal payoff in the monetary economy. Since the surplus that the government needs to leave in the agents' hands is the same in the bilateral-credit and risk-sharing economies, the same result of Section 5 holds: (*i*) if λ is sufficiently close to one, then bilateral credit is sufficiently more efficient than money that the government prefers bilateral credit; (*ii*) if λ assumes intermediate values, then the government prefers money to bilateral credit even if bilateral credit is more efficient; and (*iii*) if λ is sufficiently small, then the government prefers money to bilateral credit since money is more efficient.[27]

B.3 Taxation with Divisible Money and Divisible Goods

TO BE WRITTEN

[27] An alternative arrangement for the bilateral-credit economy would be to assume that agents who refuse to become creditors are also permanently excluded from trade. One can show that in this case the government is able to extract a greater surplus from the agents. Our conclusions would remain qualitatively the same, though.