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Sufficiency of an outside bank and a default penalty to support the value of fiat money: Experimental evidence ☆

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ABSTRACT

We present a model in which an outside bank and a default penalty support the value of fiat money, and experimental evidence that the theoretical predictions about the behavior of such economies, based on the Fisher-condition, work reasonably well in a laboratory setting. The import of this finding for the theory of money is to show that the presence of a societal bank and default laws provide sufficient structure to support the use of fiat money and use of the bank rate to influence inflation or deflation, although other institutions could provide alternatives.

1. Introduction

In this paper, we test in laboratory the proposition that the presence of an outside or central bank is sufficient to support the value of fiat money in a closed economic system with money as the medium of exchange. Laboratory evidence supports the proposition.

In a finite economy, opportunity to borrow combined with competition enables individuals to utilize any fiat money they possess to pay back debt; in essence a loan is a backwards operator in time. It enables one to buy now and pay later with currency that is accepted by the bank but would be of no further value to the agent at the end of the game (see Shubik, 1980; Dubey and Geanakoplos, 1992).

Jevons (1875), Hahn (1965, 1971), Shubik and Wilson (1977), Bewley (1986), and Kovenock (2002) among others in an extensive literature, have offered various reasons for the value of fiat or symbolic money. Most of these studies provide sufficient but not necessary conditions that include: (1) money is assumed to be wanted by most if not all to address the failure of the double coincidence of wants at low cost; (2) money provides a convenient way to trade and reduce

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transactions costs; (3) it carries default penalties (for not repaying debts); (4) its value is supported by high enough dynamic expectations;[1] (5) its issue is controlled by an outside bank that can enforce its use up to a point (Knapp, 1905); and (6) it serves as insurance against economic fluctuations (see Bewley (1986) and Karatzas et al. (1994)).[2] Conditions (3) and (5) are addressed in this paper.

Monetary theory is a complex topic involving economic optimization, expectations, trust and institutional considerations. The economic dynamics of money is often supported by several mechanisms that can be used to achieve the same ends. Here we consider the presence of an outside bank, acceptance of money in payments, and a default penalty on unpaid debt. This game has the property that the economy is able to substitute a nearly costless symbol of trade for an intrinsically valued commodity such as gold for financing transactions. While a bank is not necessary, we already know that it is sufficient to achieve this result.[3]

We investigate the behavior of a minimal economy that includes an outside bank and a default penalty on unpaid loans.[4] We address reasons (3) and (5) listed above, as both bank loans and default penalties exist in a functioning modern economy and it is straightforward to implement them experimentally. The other reasons to support the existence of fiat money merit separate investigation outside the scope of the present paper. We view financial institutions and the related laws as consequences of social evolution through custom and design. A minimal game tends to capture the design more than it captures the evolution of an institution, as the time span of evolution is generally too long to replicate and examine in laboratory.

We consider a finitely repeated game in which any money held at the end is worthless. However, there is a banking system that allows individuals to borrow in such a way that they can avoid ending the game with worthless paper. There are two treatments: the terminal period of the game is known in advance (1) with certainty, or (2) with some uncertainty.[5] Individuals can borrow at an exogenously specified money interest rate, but must pay a default penalty for ending in debt. When the terminal period is known with certainty Dubey and Geanakoplos (1992) prove that the individuals can maximize their payoff by ending the game with zero money balance. When termination is uncertain, some money will be held to retain purchasing power if the economy continues as is shown by Bewley (1986). We investigate experimentally these theoretical predictions, and find that the observed data are well-organized by the predictions of the model depending on the length of the game, the natural discount rate β for intertemporal consumption, and the bank rate of interest ρ.

Section 2 presents the theoretical structure and Section 3 the laboratory implementation of the economy. Section 4 compares the theoretical predictions of the competitive general equilibrium with data observed in laboratory economies populated by profit motivated human agents and minimally intelligent (MI) algorithmic traders (specified later in detail) simulated on a computer. Conclusions of the paper are summarized in Section 5.

2. The theory

Monetary economics deals with dynamics, and institutions are society's way of implementing the process. Multiple alternative mechanisms can serve a given financial function. An outside agency, or central bank, is a simple mechanism to actively or passively control the supply of money. Furthermore, as in history and life, there are no natural initial or terminal points to the economic process. Since experimentation in laboratory requires that initial and terminal conditions be specified, care in modeling and simplification is necessary to avoid a mismatch between theory and experimentation. In particular, our introduction of an outside bank at a high level of abstraction is little more than a passive device to provide a flexible fiat money supply by making loans at a fixed rate of interest.[6]

Neither the source and distribution of the initial supply of fiat money, nor the disposal of this supply at the end, is addressed in a typical economic model. Implementing the economy as a finite playable game forces one to account for both the source and the disposal explicitly. The initial money holdings are “outside money” without an obligation to repay. At the end of the finite game, this outside money has been consumed by interest payments to the outside bank. It is as though the government, by distributing pieces of paper to agents in appropriate proportions, initially provides them an interest free loan that can be used to finance working capital. In practice, however, individual indebtedness to the government is achieved more through taxation than through loans.

[1] For example, they might believe that prices will be stable in a booming economy in the future.

[2] Without going into technical details, for (3), if an individual has the strategic opportunity to default he will do so unless there is a sufficiently high penalty for doing so. This penalty is typically denominated in some form of disutility or loss related to the money value of the loss. For (4), see Grandmont's (1983) analysis of the role of expectations in supporting the value of money.

[3] Complexity of a modern monetary economy resides in its institutions and laws. Since they have evolved with society, assuming the existence of an outside bank is at least as reasonable as assuming exchanges based on pairwise search. The former better captures the economies we live in, while the latter is better suited to studies in early economic anthropology. They address different questions.

[4] Minimal mechanisms abstract away the details to retain only the basic features necessary to be playable in the laboratory; see Huber et al. (2010).

[5] Although the theoretical results are derived only for time horizons with certainty, we check the robustness of the certainty model by including laboratory sessions in which time horizon is uncertain. We note, but cannot deal with in detail here, that the presence of uncertainty modifies the Fisher Equation (see Karatzas et al., 2006).

[6] Game-theoretically, the outside bank is a strategic dummy; it has neither a utility function nor free strategic choice. An experimental exploration of the role of the central bank as an active control agent requires a separate investigation.