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Money: What's the Question and Why Should We Care About the Answer?

By NARAYANA R. KOCHERLAKOTA*

What economic frictions make the use of money socially beneficial? Over the past 20 years, this question has attracted a great deal of attention (see, e.g., Robert Townsend, 1987, 1989; Mark Huggett and Stefan Krasa, 1996; Kocherlakota, 1998; Nobuhiro Kiyotaki and John Moore, 2001; Neil Wallace, 2001). There is a very real sense in which this effort has been successful. It has shown that there are two crucial societal frictions that generate a role for money. First, there must be limited enforcement: society must face limitations on the penalties that it can impose for contractual nonperformance. Second, there must be limited record-keeping: society cannot costlessly create an accessible record of past events.

In another sense, however, this literature has been unsuccessful. Its main finding is that the very existence of money reveals that imperfect record-keeping and limited enforcement are essential elements of monetary economies. Yet, mainstream positive and normative analyses of monetary policy generally abstract from these frictions. In other words, the lessons of what one might call "basic" research in monetary theory have had little or no impact on the "applied" research in monetary theory.

There is a simple reason why the applied literature has by and large ignored the basic literature. Real-life monetary policy (and consequently the applied literature) is primarily about interest rates, that is, the relative price of money and claims to future money. The basic literature generally abstracts from other assets besides money, and it offers no compelling reason why societies need risk-free claims to future money as well as money itself.

In this paper, I ask two questions. The first is: What kinds of economic frictions imply that it is socially beneficial for agents to trade both money and illiquid claims to future money? The second is: Given these frictions, what is the nature of optimal monetary policy? My answer to the first question relies heavily on my analysis in Kocherlakota (2002). I consider an environment in which enforcement is limited and record-keeping is limited (as is necessary to rationalize the use of money). In addition, I assume that agents are subject to transient, privately observed, liquidity shocks. (More precisely, they experience privately observed shocks to their marginal utilities of consumption. In equilibrium, all consumption must be purchased using cash; hence, it makes sense to think of this preference shock as being a liquidity shock.) I show that, in this setting, it is socially optimal for the monetary authority to sell illiquid bonds that make risk-free monetary payments. I conclude that one can rationalize the coexistence of money and illiquid bonds as being an efficient response to privately observed liquidity shocks of this kind.

I go on to address a policy question: Given that agents are privately informed about their liquidity needs, what is the nature of optimal monetary policy? I show that the key exogenous variable that influences optimal policy is the *size* of the liquidity shock (more precisely, its cross-sectional variance). I demonstrate that, if the size of the shock is large, then it is optimal for the monetary authority to sell a large amount of bonds by offering a high nominal interest rate. This increase is followed by a decline to a new constant interest rate that is higher than the original, pre-shock, value.

Intuitively, optimal monetary policy works as follows. When the monetary authority issues illiquid bonds, they are purchased by the agents

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with a relatively low marginal utility of consumption. These agents then have less money, which drives up the purchasing power in the hands of the agents with high marginal utility. In this way, bond sales shift liquidity from those who have it to those who need it. When the cross-agent differences in marginal utilities are large, it is optimal for the monetary authority to issue more bonds and reduce the money supply. This drives down the price of the bonds and increases interest rates.

This paper is primarily connected to two literatures. I have already mentioned its linkage to the large literature that addresses the rationale for money. The paper is also related to a growing literature on the role of government intervention in economies with enforcement limitations. As in Bengt Holmstrom and Jean Tirole (1998) and Dirk Krueger and Fabrizio Perri (2001), the government can credibly commit to repay loans while private citizens cannot. Our papers differ in how the government collects the resources to make the repayments. In Holmstrom and Tirole (1998) and Krueger and Perri (2001), the government has the ability to use arbitrary penalties to enforce the payment of taxes; these penalties are not available to enforce contracts between private citizens. In my paper, the government cannot impose any penalties beyond those used to enforce private contracts. However, the government can collect resources through the inflation tax, because it is the sole provider of currency.

I. Environment

The basic structure of the economy is similar to that in Kocherlakota (2002). There is a unit measure of infinitely-lived households. There are equal measures of two types, type 1 and type 2, and there are two types of perishable goods. Each household has two members, a consumer and a producer. In a given period, a type-i producer can produce up to one unit of type-i goods (where $i = 1, 2$).

Type-i households have preferences represented by the utility function $\theta_1 \ln c_1 - \alpha y_1 + \sum_{t=2}^{\infty} \beta^{t-1}\{\ln c_t - \alpha y_t\}$. Here, c_t represents the household's consumption of type j ($j \neq i$) goods in period t, and y_t represents the amount of type-i goods produced by the household in period t. I assume that $0 < \alpha < \beta < 1$.

The variable θ_1 is random. At the beginning of period 1, all households observe the realization of a random variable z, which is equally likely to be z_* or z^*, where $z^* > z_* > 1$. Following the draw of z, each household learns its realization of θ_1. Conditional on z, θ_1 is independently and identically distributed across households and is equally likely to be $\theta_L(z) = 1$ or $\theta_H(z) = z$.

Thus, z is an aggregate shock that influences the households' needs for consumption. When $z = z^*$, half of the households have an especially urgent need for consumption in period 1. Because of the frictions described below, these needs for consumption immediately translate into needs for money. Thus, one can think of θ_1 as a liquidity shock and think of z as affecting the scale of this shock.

Throughout, when I refer to social welfare, I mean the *ex ante* utility of a typical household. This concept is well-defined, because all households are identical *ex ante*.

Spatially, there are three islands. The households begin each period on island 3. There are no production technologies available on that island. The other two islands are labeled islands 1 and 2; the production technologies for good i are located on island i. Goods are non-portable, but household members can costlessly travel between islands. There is no way to communicate between the islands.

There are three key frictions in this environment. The first is that record-keeping is limited: in a given period, households know only their own transaction histories; they do not know the transaction history of any other household. The second friction is that enforcement is limited: societies cannot impose any auxiliary penalty on households.

These two frictions immediately imply that, without money, autarky is the only achievable allocation. A producer must endure a utility cost to produce. Because enforcement is limited, the producer cannot be contemporaneously punished for failing to produce. Moreover, because there is no record-keeping, the producer cannot be rewarded in the future for producing.

Thus, people in this society need some kind of record-keeping device if they are to achieve better allocations than autarky. As will become clear (and as is well-known from previous work), money can play this record-keeping role.

Indeed, once one adds money, this environment is simply a standard cash-in-advance economy, except for the initial taste shock.

The third friction in the environment is that a household's realization of θ_1 is known only to that household. As I will show, this private-information friction implies that welfare is higher in societies in which households can use both money and bonds, as opposed to money alone.

II. Trade

Every household begins life in period 1 with one unit of a durable and divisible good called money. In each period, on island 3, a government sells one-period claims to money called *bonds*. A unit of bonds sold in period t pays off one unit of money on island 3 in period $(t + 1)$. Crucially, the bonds are *illiquid* in that households cannot transport them to islands 1 and 2; in contrast, money is fully portable and is therefore liquid. The households trade money and bonds competitively on island 3 each period, after the bonds pay off. Bonds and money are both physical assets; hence, households cannot engage in short sales of either asset.

The government commits *ex ante* to a policy $\{\{q_t(z)\}_{t=1}^{\infty}\}_{z\in\{z_*,z^*\}}$, where $0 < q_t(z) \leq 1$, for all z and t. According to this policy, given a realization of z, the government stands ready to exchange x units of bonds for $q_t(z)x$ units of money, where x is an arbitrary real number. (The policy is feasible, because the government can costlessly create bonds and money.) In words, the government commits itself to a date- and state-contingent nominal interest-rate peg.

The sequence of markets resembles that of a standard cash-in-advance economy. At the beginning of each period, agents buy/sell illiquid bonds and money on island 3 according to the government's price. The type-i producers and type-j $(j \neq i)$ consumers travel to island i. Agents located on islands 1 and 2 trade money and goods in a competitive market.

Why restrict attention to illiquid bonds? When bonds are liquid (i.e., tradable in the goods market), then they are perfect substitutes for money. They cannot expand the set of achievable allocations any more than increasing the money supply can.

III. Optimal Open-Market Operations

In this section, I provide a partial verbal characterization of the structure of optimal policy, given that production is always at full capacity (as is optimal for sufficiently low values of the labor disutility parameter α). The interested reader is referred to Kocherlakota (2001) for the mathematical details.

One important property of this economy is that it is indeed optimal to engage in some form of open-market operations. Suppose the government sets $q_t(z) = 1$ for all t, z. Because bonds are illiquid, the households make no bond purchases, and there are no open-market operations. Kocherlakota (2002) shows that, in equilibrium, all households spend all their cash in every period; hence, they consume the same amount in every period. But this equilibrium has an obvious shortcoming: in period 1, type-H households are marginally more impatient than the type-L households.

The government can use open-market operations to correct this problem. When the government sets $q_1(z)$ slightly less than β, the type-L households are willing to buy some illiquid bonds from the government. By doing so, they give up consumption in period 1 in exchange for consumption in period 2. At the same time, the relatively impatient type-H households make no bond purchases or sales. But because the type-L households buy illiquid bonds, the period-1 price level falls and the period-2 price level rises. The type-H households end up consuming more in period 1 and less in period 2.

Thus, an open-market operation generates a loan from the type-L households to the type-H households. One can find the optimal open-market operation by maximizing social welfare with respect to the size of this inter-household loan. Not surprisingly, the size of this optimal loan is an increasing function of the marginal utility gap z; it follows that, for larger values of z, it is optimal for the monetary authority to sell a larger amount of bonds in period 1 at a lower price. In this sense, in optimal open-market operations, large liquidity shocks (large z) are associated with nominal interest-rate increases.

After a period-1 issue of bonds, the type-L households have more purchasing power in

period 2 than in any period $t > 2$. The monetary authority must issue enough bonds in period 2 (and thereafter) to allow these households to smooth their extra purchasing power over time. This guarantees that the period-t nominal interest rate (while always lower than the period-1 interest rate) is also increasing in z.

IV. Conclusion

A key policy conclusion of this paper is that the optimal monetary policy specifies that the money supply is a *decreasing* function of the liquidity shock z. This counterintuitive result comes directly from the assumption that the monetary authority cannot observe the liquidity needs of the households in the economy. If the authority did have this information, its optimal policy would be quite different: it would simply give newly printed money to the agents with the most severe liquidity needs. A large liquidity shock would then be associated with infusions of money, not reductions of money. In other words, *the form of optimal monetary policy is shaped entirely by the very friction that rationalizes the coexistence of illiquid bonds and money.*

This result is an important lesson for the vast economic literature concerning monetary policy. Both positive and normative analyses of monetary policy hinge crucially on the types of frictions present in the economy. Unfortunately, economists have surprisingly little direct information about the exact nature of these frictions. The message of this paper is that one can learn much about these frictions, and the resultant implications for monetary policy, from the very fact that money and illiquid bonds are both traded.

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