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Money and markets

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Abstract

In a search model of endogenous money it is shown that the introduction of markets increases the efficiency of the economy. Markets help the agents to coordinate their actions. The organization of the economy in markets becomes feasible only with the introduction of money. Unlike in a marketless economy the commodity holder's decision to actively move and search or to wait for a buyer becomes irrelevant.

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1. Introduction

There is a close connection between money and markets. Both price formation and trading are thought to take place in markets. The more organized and extensive the markets are, the easier it is to use money in transactions. In a study of medieval money, Spufford (1988, pp. 75) observes the connection: 'the market was not for barter, but for selling and buying with money . . . .'

In this paper we study the connection between endogenous money and markets. We employ the search framework used by Kiyotaki and Wright (1993) and Burdett et al. (1993) to investigate how the emergence of markets affects the functioning of a monetary economy. In the latter article the agents can either actively search by moving or passively stay and wait for trading partners. It is shown that this decision becomes less important when the economy is organized into markets.

The kind of search models that we study can be thought to depict the least organized form of economic activity. The agents' tastes are differentiated and they search for trading opportunities. Every agent can produce one specific kind of good. The agents have an equal chance of meeting any agent and they trade only if both agree, i.e. when there is a double coincidence of wants. In a non-monetary economy pure barter is the only mode of trade. If there are many different goods the introduction of money, a generally accepted medium of exchange, speeds up trade because in any pairwise meeting there need to be only a single coincidence of wants. In this environment markets are characterized by locations. A certain good is offered for sale in a certain location, a market for that good. The agents can now coordinate their search to a certain location where they have a greater chance of finding the good they desire than in the marketless search economy.

2. The model

There is a continuum of infinitely lived agents whose mass is normalized to unity. The goods as well as the agents are divided into k types of equal measure. An agent of type i always produces a good of type i. The agents consume different goods at different times depending on the taste shocks they receive. When an agent receives a taste shock for good j he goes searching for the good. Only after consuming good j does he receive a new taste shock and is able to produce again. Consumption yields utility u. If agent i receives a taste shock for good i he immediately produces good i and consumes it, after which he receives a new taste shock. Production is assumed to be costless. Some agents are endowed with non-consumable and non-producible fiat money. Both money and goods are indivisible and the agents can carry only one unit of either money or a good at a time. Accepting money is assumed to be costless, while accepting a good costs $\varepsilon > 0$ is utility.

If an agent moves and searches for trading opportunities he can meet both other movers and stayers. If an agent stays, he can meet only movers. It is assumed that the arrival rate of trading opportunities for stayers is proportional to the number of movers, while the arrival rate of trading opportunities for movers is independent of the number of movers and stayers. As in Burdett et al. (1993) we normalize the arrival rate for movers to unity. Then the arrival rate for stayers is the fraction of movers. Burdett et al. (1993) give the following intuition to this search technology. There is a given number of physical locations and individuals. The movers sample locations randomly and their meeting probability is the number of all agents divided by the number of locations. For a stayer the meeting probability is the number of movers divided by the number of locations, since only movers come to stayers.

The search economy with costless moving, and everybody moving, is regarded as a benchmark case. It can be analysed with the help of value functions. Denote by V_1, V_m and V_0 the value functions of an agent with a commodity for trade, of an agent with a unit of money and of an agent who has just gotten his consumption good, respectively. The value functions are determined by the following equations:

$$V_0 = u + \frac{1}{k} V_0 + \frac{k-1}{k} V_1 = \frac{k}{k-1} u + V_1 , \tag{1}$$

$$rV_1 = \max_{\pi} \left\{ \frac{1-m}{k(k-1)} (V_0 - \epsilon - V_1) + \frac{m}{k} \pi (V_m - V_1) \right\} , \tag{2}$$

$$rV_m = \frac{1-m}{k} \Pi (V_0 - \epsilon - V_m) . \tag{3}$$

In the first equation the agent who has gotten his consumption good immediately eats it, getting utility u. After this he produces another good and receives a new taste shock. With probability $1/k$ it is the same as his production good and with probability $(k-1)/k$ it is some other good. In the first case his expected utility is V_0 and in the latter case V_1. In eqs. (2) and (3) r denotes the rate of discount and the right-hand side can be thought to express the return from holding a unit of good and a unit of money, respectively. In (2) an agent with a good for trade maximizes over the probability of accepting a unit of money. With probability 1-m he meets a commodity holder and with probability $1/k(k-1)$ there is a double coincidence of wants. With probability m he meets a money holder and with probability $1/k$ the money holder wants the good offered. In (3) something happens to the money holder only if he meets a commodity holder, which takes place with probability $1-m$. All the other traders are assumed to accept money with probability Π. Burdett et al. (1993) show that $\pi = 1$ is the best response to Π when $\Pi > 1/(k-1)$. In other words, there exists a monetary equilibrium in which money is always accepted. In what follows we study a monetary equilibrium.

By markets we mean sets of locations delineated in such a way that all the holders of good j come to the specific set of locations to sell their goods. Anybody desiring good j can direct his search to this set and to be certain that upon meeting a commodity holder he has found good j. Otherwise the search process is similar to that above. Next we examine the economy with k markets. Since $1/k$ of the money holders and commodity holders go to each of the k markets, every market is similar to the economy without markets except that all the commodity holders possess the same kind of good. The value functions of the agents in this case are denoted by W and the subscripts are as before. We also allow the commodity holders the decision to move or stay, while the money holders are assumed to move. Superscripts S and M denote the decision to stay and move, respectively. Denote by n the proportion of the commodity holders who move:

$$W_0 = \frac{k}{k-1} u + \max(W_1^{\mathrm{S}}, W_1^{\mathrm{D}}) . \tag{4}$$

$$rW_1^{\mathrm{S}} = m(W_{\mathrm{m}} - W_1^{\mathrm{S}}) + n(1-m)0[W_0 - \epsilon - W_1^{\mathrm{S}}] , \tag{5a}$$

$$rW_1^{\mathrm{M}} = m(W_{\mathrm{m}} - W_1^{\mathrm{M}}) + (1-m)0[W_0 - \epsilon - W_1^{\mathrm{M}}] , \tag{5b}$$

$$rW_{\mathrm{m}} = (1-m)(W_0 - \epsilon - W_{\mathrm{m}}) . \tag{6}$$

Eq. (4) is analogous to Eq. (1). The right-hand sides of Eqs. (5a) and (5b) give the return from holding a good for trade when staying and moving, respectively. A commodity holder goes to the market for that good to sell it. A proportion m of the agents in this market are money holders. Even though in (5a) the probability of meeting a commodity holder is less for a stayer than for a mover in (5b), $n(1-m) < 1-m$, it is meaningless, since the probability of finding one's consumption good is zero. This is caused by the fact that all the commodity holders in the market possess the same good. Thus, it does not matter whether the commodity holders move or stay when the economy is organized into markets and moving is costless. To simplify the analysis we assume that commodity holders always stay and we denote the value function of commodity holders by W_1. The right-hand side of (6) gives the return from holding a unity of money. With probability $1-m$ money holders meet a commodity holder and then they trade for certain, since the commodity holders in this market have just the good the money holders want.

Costly moving could be analysed without difficulty. Commodity holders would stay and there would be some upper bound of moving costs beyond which nobody finds moving profitable. Then there would be no trade either.

It is a routine exercise to check that $V_{\mathrm{m}} > V_1$ holds when $k \geq 3$ and $W_{\mathrm{m}} > W_1$ always holds. It is also easy to check that both $W_{\mathrm{m}} > V_{\mathrm{m}}$ and $W_1 > V_1$ hold for sufficiently large k which depends on m and r. Denote by k^* the smallest of such k. We want to show that in an economy with money and markets the agents behave in equilibrium in the following way. The commodity holders always go to the market for their production good to sell it for a unit of money, and the money holders go to the market for their consumption good to buy it for a unit of money. Clearly, the money holders never want to go to any other market but that of their consumption good. Assume that a commodity holder considers deviating from the proposed equilibrium strategy by going to the market for his consumption good holding his production good instead of money. We calculate the value function for a one time deviation, W_1^{D}, and derive a condition for it being less than W_1. The deviator, of course, moves:

$$W_0 = \frac{k}{k-1} u + W_1 , \tag{7}$$

$$rW_1^{\mathrm{D}} = \frac{1}{k-1}(1-m)(W_0 - \epsilon - W_1^{\mathrm{D}}) , \tag{8}$$

$$rW_m = (1 - m)(W_0 - \epsilon - W_m) . \quad (9)$$

The right-hand side of (8) gives the return from once deviating by going to the market with a good instead of money. None of the money holders in this market desired the good of the deviating agent. With probability $1 - m$ he meets a commodity holder who desires the good of the deviating agent with probability $1/(k - 1)$. From (7)–(9) it is easy to solve for W_1^D. Condition $W_1^D < W_1$ reduces to $r + 1 < m(k - 1)$. Since the number of goods, or markets, is sufficiently large, the most profitable strategy is always first to sell one's own production good and then to acquire one's consumption good with money. Denote by k' the smallest value of k that guarantees the above inequality. Now, when $k \geq \max\{k^*, k'\}$ everybody in the economy first sells his production good in the proper market and then buys his consumption good in the proper market. Furthermore, in the economy with markets everybody's welfare is higher than in the economy with no markets. When k approaches infinity both V_1 and V_m approach zero while both W_1 and W_m, being independent of k, are bounded away from zero. The larger the number of goods the more sense it makes to have the economy organized in markets.

3. Conclusion

We have shown in a search model that introduction of markets can improve the efficiency of an economy by enabling the agents to coordinate their actions. It is remarkable that this would not be feasible in the absence of money. In pure barter all transactions involve a one-for-one swap. If the agents with a good for sale go to the markets for that good, then no two agents with a different good ever meet and there is no trade. Or, functioning markets in pure barter require extensive coordination so that some agents with a good go to the market for that good in order to sell it and some other agents go to different markets in order to buy their own consumption good. The third possibility would be to have $k(k - 1)/2$ markets. In one market good i would be exchanged for good j and in another market good i would be exchanged for good $h \neq j$. This kind of model has been studied by Iwai (1988) and most of the insights of this study can be found in his article. The only thing he does not deal with is the decision of the commodity holders to move or stay. In a monetary economy with markets it does not matter whether the commodity holders move or stay as long as the money holders move.

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