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Notes

Equilibrium using credit or money with indivisible goods ☆

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Abstract

This note studies the trade of indivisible goods using credit or money in a frictional market. We show how indivisibility matters for monetary equilibrium under different assumptions about price determination. Bargaining generates a price and allocation that are independent of the nominal interest or inflation rate over some range. This is not the case with price posting and directed search. In either case, we provide conditions (the nominal rate cannot be too high) under which stationary monetary equilibrium exists, and we show it is unique or generically unique.

JEL classification: D51; E40

Keywords: Bargaining; Competitive search; Indivisibility; Uniqueness

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1. Introduction

The New Monetarist framework has been increasing in popularity, with applications in areas such as finance, payment systems, and monetary policy analysis (see the survey by Lagos et al., in press). The earliest search-based models of Kiyotaki and Wright (1989, 1993) had indivisible goods and indivisible money, making every trade a one-for-one swap. Later, Shi (1995) and Trejos and Wright (1995) kept indivisible money but introduced divisible goods to determine prices. Subsequently, Shi (1997) and Lagos and Wright (2005) made both goods and money divisible. This note completes the picture by exploring the remaining case of indivisible goods and divisible money.

Far from being merely a mathematical exercise on the remaining logical possibility, we think this is substantively important. Many goods are, in fact, indivisible, and continuous divisibility is often an abstraction designed to make the analysis easier, not for the sake of realism. We take indivisibility seriously, and show how it matters in pairwise trading. To make the environment comparable with previous models (e.g., Shi, 1995 or Trejos and Wright, 1995), our consumers want to consume exactly one unit. We explore equilibrium with credit and with money. We consider bargaining with random search as well as price posting with directed search.[1] Under credit, buyers do not incur a cost from bringing a resource to trade. However, they do with money and this matters, especially under bargaining. We also consider lotteries, which can be part of an efficient trading mechanism with indivisibility.

With pure credit, equilibrium exists uniquely, and all potential buyers participate in the market, with bargaining or with price posting. With money, the outcome depends on the mechanism that determines the terms of trade. With bargaining, as long as the nominal interest rate is not too high, (stationary) monetary equilibrium exists uniquely. In this equilibrium, buyers bring the lowest amount of money necessary to make sellers indifferent between trading or not trading, akin to making take-it-or-leave-it offers. For a low range of nominal interest rates, all potential buyers participate in the market, and money is superneutral – inflation does not affect the real allocation. However, for a higher range of nominal interest rates, not all buyers participate, and the allocation is affected by inflation. These results hold with and without lotteries.

With price posting, it is easy to show lotteries are not necessary. We again show existence, and generic uniqueness, as long as the nominal interest rate is not too high. As with bargaining, when the nominal interest rate is low, all buyers participate. By increasing the nominal rate, eventually, some buyers stop participating, and ultimately the monetary equilibrium ceases to exist. Because the equilibrium price depends on the number of participating buyers under competitive search, while it does not under bargaining, the threshold for the nominal interest rate differs between bargaining and price posting. In summary, the indivisibility of goods and the mechanism for determining the terms of trade have important implications on the ability of money to generate real effects.

There is some related work on divisible money with indivisible goods, but it focuses only on random rather than competitive search. In Green and Zhou (1998), indivisibility together with posting and random search leads to indeterminacy of monetary steady state. Those results are extended to an environment closer to our setup by Jean et al. (2010) with fiat money and Rabinovich (2016) with commodity money. Our results show how this indeterminacy problem

[1] Price posting with directed search is often called competitive search (Moen, 1997; Mortensen and Wright, 2002). It has been used in monetary economics by Julien et al. (2008) with indivisible money, and by Rocheteau and Wright (2005) and Lagos and Rocheteau (2005) with divisible money.