Limelight on dark markets: Theory and experimental evidence on liquidity and information

Aleksander Berentsen\textsuperscript{a,\textsuperscript{*}}, Michael McBride\textsuperscript{b}, Guillaume Rocheteau\textsuperscript{c}

\textsuperscript{a} Department of Economics, University of Basel, Switzerland, and Federal Reserve Bank of St. Louis, USA
\textsuperscript{b} Department of Economics, University of California, Irvine, Experimental Social Science Laboratory, USA
\textsuperscript{c} Department of Economics, University of California, Irvine, USA

\textbf{Abstract}

We investigate how informational frictions affect trading in decentralized markets in theory and in a laboratory setting. Subjects, matched pairwise at random, trade divisible commodities that have different private values for a divisible asset with a common value (interpreted as money). We compare a bargaining game with complete information with a bargaining game where agents can produce fraudulent assets at some cost and are privately informed about the quality of their assets. The threat of fraud strongly reduces the subjects’ ability to exploit the gains from trade, it reduces significantly both the size of the trade and the acceptability of the asset, but only a small fraction of all assets are actually fraudulent.

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1. Introduction

"Cognizability: by this name we may denote the capability of a substance for being easily recognized and distinguished from all other substances. As a medium of exchange, money has to be continually handed about, and it will occasion great trouble if every person receiving currency has to scrutinize, weigh, and test it. If it requires any skill to
discriminate good money from bad, poor ignorant people are sure to be imposed upon. Hence the medium of exchange should have certain distinct marks which nobody can mistake (Jevons (1875, Chapter 5)).

As far back as Jevons (1875), at least, it has been commonly accepted that a key property of a monetary asset – broadly defined as an asset that serves as a means of payment or collateral – is its recognizability, the fact that an asset can be authenticated at little cost. Throughout monetary history assets that lacked recognizability have been subjected to counterfeiting and fraud, e.g., the clipping of coins in ancient Rome and medieval Europe, and the counterfeiting of banknotes during the first half of the 19th century in the United States (Sargent and Velde, 2012; Mihm, 2007). More recently, problems arising from private information problems and fraud regarding collateral have played a crucial role in the unfolding of the 2007-08 financial crisis and the drying-up of liquidity in over-the-counter (OTC) markets, such as the market for bilateral repurchase agreements (repos). According to Duffie (2012, p.2) private information problems are prevalent in decentralized asset markets with search and bargaining:

"An OTC bargaining game can be complex because of private information (...). The counterparties may have different information regarding the common-value aspects of the asset (for example, the probability distribution of the asset's future cash flows), current market conditions, and their individual motives for trade."

The search-theoretic approach to monetary exchange (Shi, 1995; Trejos and Wright, 1995) and OTC trading (Duffie et al., 2005) provides theoretical foundations for decentralized markets – markets with pairwise meetings and bargaining – in which agents trade assets (e.g., money, real assets, financial securities) in the absence of private information. This literature has been recently extended to introduce the possibility of counterfeiting and asset fraud and to analyze bargaining games under private information, e.g., Nosal and Wallace (2007), Li and Rocheteau (2011), Li et al. (2012), Hu (2013) and Shao (2014). These models have proven useful to explain how the threat of fraud affects the liquidity of assets (e.g., their acceptability and pledgeability) as well as the coexistence of assets with different rates of return – a puzzle in monetary theory. Moreover, they provide a simple narrative for the recent financial crisis – a class of assets became vulnerable to fraudulent practices, which reduced aggregate liquidity and led to a flight to quality.

There are two concerns with this theoretical literature, both of which can be addressed by an experimental approach. First, models of bargaining in decentralized markets with informbut all offers should get rejectionsal frictions can generate multiple (perfect Bayesian) equilibria with different sets of predictions depending on how the equilibrium set is defined. The fact that equilibrium allocations are sensitive to the choice of the equilibrium concept generates a need to confront these theories with real observations. A second concern is the stark prediction of these models according to which counterfeiting is not an equilibrium phenomenon – it is an out-of-equilibrium threat – unless fraud is costless. This prediction of the theory has important policy implications as it suggests that measures to make media of exchange recognizable should be implemented irrespective of realized fraud. In actual economies, however, fraud and counterfeiting do happen. The experimental approach can help us understand if counterfeiting corresponds to a behavioral response to the possibility of fraud that is not captured by our model or whether it is an out-of-equilibrium phenomenon that vanishes as subjects learn about the environment.

The environment we implement in a laboratory setting is an extension of the decentralized market with random matching and bargaining under private information of Li et al. (2012), LRW thereafter. In contrast to LRW we impose linear payoffs, which makes the environment easier to apprehend for the subjects but also generates new insights for the effects of the threat of fraud on asset liquidity. Under a natural timing assumption, our modified bargaining game has a multiplicity of Perfect Bayesian Nash equilibria. To address this issue, we apply the reordering invariance refinement of In and Wright (2011) for signaling games with hidden actions. This refinement generates a limited set of equilibria that are payoff equivalent and all feature the same no-counterfeiting property. Relative to LRW, our game has the novel implication that it can generate equilibria with both limited pledgeability (i.e., agents only trade a fraction of their asset holdings) and partial acceptability of assets (i.e., a fraction of offers get rejected) – the two key dimensions of asset (il)liquidity. Moreover, equilibria feature a trade-off between trade sizes and acceptability – larger offers take longer to be accepted. Finally, we extend the theory to

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1 Prior to the 2008 crisis, asset-backed securities (ABSs) were used as collateral, and trillions of dollars were exchanged on the repo market without any extensive due diligence (Gorton and Metrick, 2010). When market participants realized that ABSs could be of dubious quality and the private information of asset holders became relevant, assets that had served as collateral were subject to prohibitive haircuts and liquidity in money markets dried up dramatically.

2 Trejos and Wright (2014) provide a framework nesting the Duffie-Garleanu-Pedersen model of OTC trading and the Shi-Trejos-Wright model of monetary exchange.

3 This result holds for both signaling games where asset holders with private information make offers (e.g., Nosal and Wallace, 2007; Li et al., 2012; Hu, 2013) or screening games where the buyers of the asset are the ones to make offers (e.g., Shao, 2014). There are exceptions. Li and Rocheteau (2011) obtain counterfeiting in equilibrium by introducing some price posting in the Nosal-Wallace model. However, as shown by Shao (2014), this result is not robust if search is directed. Li et al. (2012) obtain counterfeiting in equilibrium in one extension of their model where the cost of fraud is random but offers cannot be made contingent on that cost.

4 For instance, in 2005, out of the $760 billion of U.S. banknotes in circulation $61 million of counterfeit currency was passed on to the public. See “The use and counterfeiting of United States currency abroad,” Part 3, page 47. Also, according to the estimate by Judson and Porter (2001) counterfeit U.S. currency that has been passed into circulation is about one note in ten thousands of currency in circulation.

5 Lester et al. (2011) can obtain the partial acceptability of assets in a related setting by assuming a cost to authenticate assets and accept an offer.
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