

Decentralized Marketplaces with Privately Enforced Contracts: A Case Study of OpenBazaar

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Abstract

Multisignature escrow, coupled with blockchain, enables self-enforcing contracts by allowing parties to precommit to the terms of an agreement and thereby reduce, or eliminate, their ability to commit fraud. Many mainstream financial institutions are experimenting with blockchain-related platforms that use multisignature escrow to assist in trading debt instruments and commodities. One novel implementation was the decentralized trading platform OpenBazaar, which directly connected buyers and sellers and ran on open-source software. Buyers' payments were held in escrow until either both parties agreed that a contract was fully honored or a third-party mediator sided with one party. The firm supporting the marketplace failed to monetize its investments and stopped supporting the software. Despite OpenBazaar's demise, it lives on in decentralized cryptocurrency applications, nonfungible-token marketplaces, and illicit darknet marketplaces. Studying its key features gives insights about the prospects and limitations of decentralized marketplaces and the use of smart contracts and multisignature escrow.

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I. Introduction

As trade moves beyond face-to-face spot markets, the potential problem of opportunism or fraud arises. If one deals with the same individuals on a repeated basis, one can rely on reciprocity or the discipline of continuous dealings to incentivize them to follow through on promises. Or if one is making a trade in person, buyers and sellers can examine the goods and the money they are exchanging and have their hands on the goods and money until the moment of an exchange. But as commerce expands beyond tight-knit groups and takes place over time and distance, buyers and sellers need to worry that the other party will promise one thing but do another. In theory one could take a cheat to court, but when the associated costs far exceed what is at stake in an exchange, doing so is impractical.

Over the past two decades, electronic-commerce firms including Amazon, eBay, and PayPal have provided important solutions to fraud by serving as reputational intermediaries. A buyer and seller may not have a prior contractual relationship with each other, but the intermediaries have a contractual relationship with everyone involved and can provide assurances that both get what they are owed. The importance of such solutions for markets should not be underestimated, and these firms have profited immensely because of what they have done. Yet even these firms have limits and choose to only connect people in certain countries and conduct business for certain goods. PayPal, for example, chooses not to process payments for resold sports tickets and will not do business with anyone in various countries, such as the Democratic Republic of the Congo or Iran.

One of the most novel and potentially innovative recent technologies to let nearly everyone interact is algorithmically enforced *smart contracts* coupled with blockchain technology to create open and decentralized marketplaces. Smart contracts, in which terms of an agreement are automatically executed when certain conditions are met, have the potential to allow parties to precommit to following through with their end of the bargain.

Different people have somewhat-different definitions of what a smart contract entails. Some commentators define them as existing *only* where computer algorithms judge a set of agreed-upon stipulations to determine the satisfactory execution of the terms of the agreement.¹ This

¹ We appreciate our friends William Luther and Thomas Hogan for taking the hard-line position on this that smart contracts are only algorithmically enforced. For more on this debate, see Mik (2017). Our paper describes a system of contracts involving

is from where the “code is law” perspective comes. Szabo (1994) defines smart contracts as those in which “a computerized transaction protocol that executes the terms of a contract,” but Szabo (1994, 1996) also carves out exceptions whereby humans may intervene, such as when operational errors or hardship—both of which are difficult for an algorithmic protocol to detect and parse—come into play.² In this paper we discuss multisignature-escrow technologies as a specific type of smart contract: one in which a series of if-then statements are programmed and executed when certain conditions are met, sometimes requiring the intercession of an intermediary, and the execution is beyond the transacting parties’ control.

One of the earliest widescale rollouts of smart contracts with multisignature escrow was found in the online marketplace OpenBazaar. Founded in 2014 and released in 2016, the platform was a decentralized peer-to-peer marketplace that aimed both to be resistant to government restrictions on trade and to use technology to reduce opportunism and fraud. Like many projects in the blockchain-and-cryptocurrency space, it was meant to be decentralized but also supported by some core developers hoping to profit off the ecosystem. The main firm, OB1, drew investments from top venture capital firms Andreessen Horowitz and Union Square Ventures but never figured out a way to monetize its investments and in 2021 shut down. The issues related to its closure are unrelated to the use of multisignature escrow, the main focus of this article.

This article provides a case study of OpenBazaar’s proprietary internal multisignature-escrow system. A buyer’s funds on a blockchain were held in escrow, and the buyer and seller precommitted to be bound, in the event of a dispute, by the decision of a third-party mediator who irreversibly transferred the funds to the seller or back to the buyer. The terms were executed without either the buyer’s or seller’s direct control. Section 2 introduces smart contracts and their potential for addressing retail fraud. Section 3 describes the

algorithms and multisignature escrow. Authors including Seberino (2018) include these agreements under the umbrella of smart contracts.

² Szabo (1994) writes: “For example, a car might be rendered inoperable unless the proper challenge-response protocol is completed with its rightful owner, preventing theft. If a loan was taken out to buy that car, and the owner failed to make payments, the smart contract could automatically invoke a lien, which returns control of the car keys to the bank. This smart lien might be much cheaper and more effective than a repo man.” But Szabo also introduces various possibilities that imply human involvement and judgment: “Also needed is a protocol to provably remove the lien when the loan has been paid off, as well as hardship and operational exceptions.”

functioning of OpenBazaar. Section 4 provides details on multi-signature escrow, OpenBazaar's primary approach to address fraud. In section 5, we compare OpenBazaar's multisignature-escrow approach with two traditional ways of enforcing contracts: ex post legal enforcement and ex post private enforcement. Section 6 discusses the effectiveness of multisignature escrow in preventing or mitigating the types of fraud likely to occur in a fully decentralized retail market, and in section 7 we conclude.

II. An Overview of Multisignature-Escrow Technology Coupled with Blockchain Technology

Smart contracts provide a potential way to protect buyers and sellers from fraud when transacting with blockchain technology in the absence of a trusted intermediary. The functioning of any retail market requires confidence that parties are not exposed to prohibitively severe amounts of fraud. This has become particularly important with the emergence and vast growth of electronic commerce, whereby counterparties from around the world have been brought together to transact, as the welcome prospect of broader and deeper global markets has invariably been accompanied by new challenges involving fraud and other forms of commercial malfeasance. With the increasingly impersonal nature of virtual marketplaces, retailers and market participants typically have little if any personal knowledge about one another, allowing online fraudsters to conceal their identity and launch high-impact or repeat attacks. Traditional ex post enforcement by legal systems is often infeasible, as the legal costs often exceed the value of fraud (Stringham and Clark 2020).

Consider the typical online merchant, which reports an average of 156 successful cases of fraud per month with a mean value of \$113 (LexisNexis 2016). Given that even an initial consultation with an attorney costs more than \$113, virtually no merchant chooses to take individual cases to court. To date, parties have relied on various private mechanisms to deal with fraud. Much of what a company like PayPal does is help prevent fraud from occurring.³ PayPal also operates its own dispute-resolution system to deal with problems after they occur. These payment networks or platforms can tailor their private systems to the specific requirements of retail transactions on

³ Payment platforms such as PayPal rely on ex ante mitigation of fraud, using data they gather to decline the transactions most likely to be fraudulent or flag them for increased scrutiny. See Stringham and Clark (2017) for a detailed discussion of PayPal's ex ante fraud-mitigation system.

their platforms, making it far more efficient than courts at resolving such disputes. Indeed, private governance brings many of the same advantages to broader social, economic, and organizational spheres (Stringham 2015).

The advent of blockchain technology, which is associated with cryptocurrencies, offers both new opportunities and challenges regarding fraud. Parties transacting in cryptocurrencies are more anonymous than in traditional e-commerce, making ex post enforcement of fraud even more difficult. Moreover, few entities have the resources of PayPal, which either mitigates fraud ex ante through predictive analytics or pursues remedies ex post through mediation. The decentralized nature of blockchain technology therefore requires novel solutions to the problem of fraud.

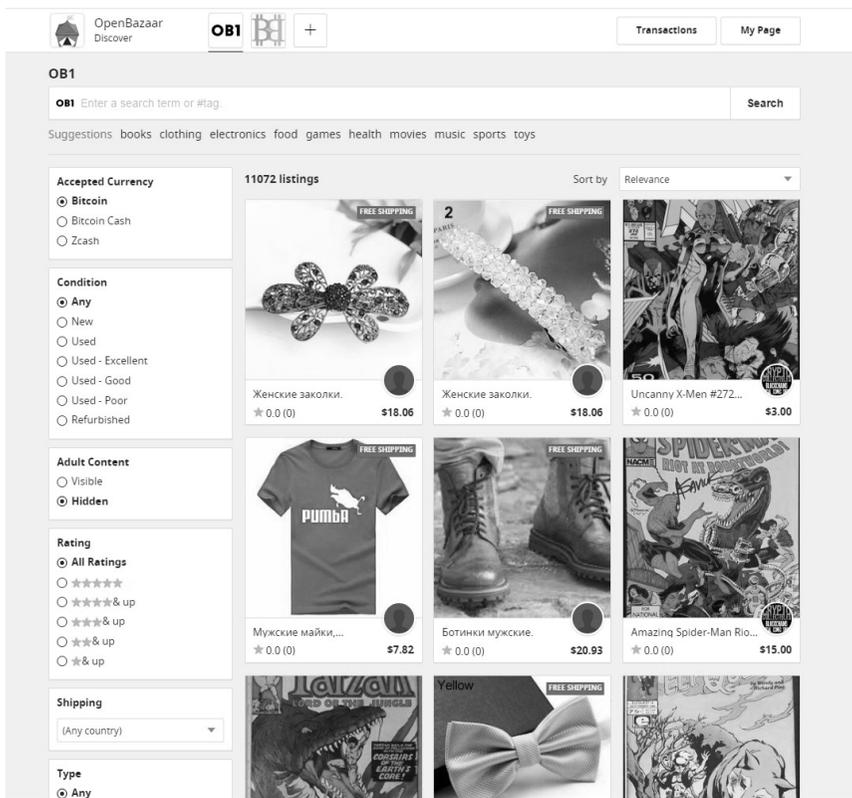
Algorithmically enforced smart contracts have emerged to address fraud in decentralized retail platforms. Raskin (2017) describes smart contracts as “agreements whose execution is automated. This automatic execution is often effected through a computer running code that has translated legal prose into an executable program.” If the algorithm determines that certain conditions have been met, it automatically executes the terms stipulated in the contract. Automated execution of smart contracts allows the parties to precommit to honoring the agreement, essentially substituting for ex post enforcement either by the legal system or private mediation.

III. The Decentralized Marketplace OpenBazaar

OpenBazaar put to use blockchain technology and a specific type of smart contract, multisignature-escrow technology, to create a fully decentralized retail platform. Rather than being a company or other organization, OpenBazaar was simply open-source software that let users create peer-to-peer connections with which individuals could buy and sell any good or service and transact in Bitcoin. Some of the advantages touted by OpenBazaar of a fully decentralized retail marketplace were that it did not require the payment of fees to an intermediary or the use of a bank or credit card and that it did not censor what was bought or sold (OpenBazaar 2015). In retrospect we think the lack of fees was the main feature that led to its demise, as most other marketplaces take a small fee for helping put together an exchange. A small fee is not an issue for users, and it helps fund the businesses sponsoring or supporting a marketplace. But hindsight is always twenty-twenty.

Figure 1 shows examples of products that were listed on OpenBazaar. Sales data are scant, but we estimate that 2018 was the peak year for OpenBazaar. As of February 2018 there were over 200,000 listings on the platform. To give an example, the books category had 30,000 listings. Project lead Brian Hoffman reports that the desktop software was installed 250,000 times and the mobile application had 100,000 users (Hochstein 2021).

Figure 1. Product listings on OpenBazaar



Established marketplaces such as eBay and Etsy connect small individual buyers and sellers, but those buyers and sellers all go through the centralized marketplace and pay the owner of the marketplace a fee. What distinguished OpenBazaar was that there was no centrally owned platform. OpenBazaar was essentially a program that allowed users to search for and connect to other users on a peer-to-peer basis, similarly to file-sharing services such as Napster during the early years of the internet.

The computer code that became OpenBazaar began development in 2014, with developer Brad Hoffman taking over the project and creating the name OpenBazaar later that year. The main developers also started a for-profit company called OB1, which offered search functionality, a mobile app, and other features in the OpenBazaar ecosystem.⁴

Given the lack of explicit censorship, concerns abounded that OpenBazaar could become the next Silk Road: a haven for the sale of drugs, weapons, and other illicit items.⁵ There were black market products for sale on the platform, and version 2.0, which was launched in November 2017, included functionality with the darknet browser Tor for the first time. But unlike Silk Road and other darknet marketplaces, OpenBazaar did not focus specifically upon illicit goods and its main search engine filtered them out.

Apart from Bitcoin payment and multisignature escrow, the feature that most distinguished OpenBazaar was the selection of potential mediators to resolve disputes. The setup had mediators compete along many dimensions, including expertise, pricing, and real-world credentials. Because multisignature-escrow systems depend on reliable and accurate mediation, the advantages and disadvantages of decentralized mediator selection are very important. We discuss the merits of this aspect of the platform below.

IV. OpenBazaar's Multisignature-Escrow System

Although Szabo (1994) sketched a theory of smart contracts in 1994, it was not until 2014 when OpenBazaar became one of the first cases of large-scale implementation of the theory (O'Brien 2014). Its approach combined commitment mechanisms of multisignature escrow with decentralized mediation (or what OpenBazaar called moderation). In most cases, the prospective buyer deposited funds in a designated Bitcoin wallet that required two of three signatures for the funds to be released. As OpenBazaar (2016a) notes, there were five possible outcomes:

1. Buyer and seller are both satisfied and release funds to the seller;
2. Seller cannot deliver and buyer is unhappy; they mutually agree to release funds back to the buyer;

⁴ The developers launched the OpenBazaar Token in 2018. This is fully distinct from the cryptocurrency that changes hands in the retail transactions we analyze in this paper; it instead relates to advertising and priority product placement by vendors.

⁵ Silk Road and equivalent marketplaces were themselves intermediaries, not fully decentralized like OpenBazaar.

3. In a dispute, a mediator finds in favor of buyer and along with buyer's signature releases funds to buyer;
4. In a dispute, a mediator finds in favor of seller and along with buyer's signature releases funds to seller;
5. The mediator finds that neither or both parties at fault; joins with either party to release funds in a split.

Buyers and sellers had to abide by the mediator's decision because they had agreed that the outcome would be executed without their direct consent. While a buyer or seller could, theoretically, bring an OpenBazaar dispute to a public court, the anonymity features of the platform would make that basically impossible.

OpenBazaar's decentralized marketplace required sellers to select multiple mediators with whom they were willing to work. Buyers would choose from that list at the time of sale (OpenBazaar 2016b). Mediators listed flat or percentage fees they would charge should cases go to dispute resolution and were encouraged to provide extensive policy documents that outlined their credentials, the rules or procedures that they followed, and the scope of transactions on which they were willing to work. Some, for example, stated that they were not willing to mediate disputes involving illicit goods or transactions they considered illegal or unethical. OpenBazaar itself did not ban the listing of, or transactions in, illicit or illegal goods but did not permit searches for such goods via the proprietary OB1 search engine. Users intent upon locating illegal or illicit goods on the peer-to-peer marketplace had to use other, externally developed search engines. Yet owing to many mediators' unwillingness to include such goods in their deliberative mandate, it may have created an informal barrier to trading certain goods.

While policies substantially varied across mediators, it is instructive to look at a concrete example in some detail to understand how the mediation process worked. We interviewed Jacob Ian Long, a Florida attorney who offered his mediation services on OpenBazaar starting when the network was in its infancy in 2014. He charged a fee of 1 percent of the good's or service's value for a specifically defined set of routine disputes and a fee of 10 percent for all other disputes. While doing so was optional, he provided his name and contact information publicly and stated that he would not mediate disputes involving transactions punishable by criminal law in the buyer's or seller's jurisdiction.

The mediation process began when one of the parties to a transaction (the claimant) contacted Mr. Long through a messaging

system in the OpenBazaar application. He then contacted the other party (the respondent) with the details of the dispute, conveying the claimant's desires.

Mr. Long designated three categories of dispute for expedited mediation: when a tracked item was marked as delivered but the buyer failed to release funds from the escrow wallet within twenty-four hours, when the buyer failed to release funds for an untracked item within ten days (or twenty days for international transactions), and when the seller failed to mark an item as shipped in the OpenBazaar system within one day of purchase. In the first two cases, the buyer had two days after the dispute was initiated to respond, after which time Mr. Long would release funds to the seller. In the third case, the seller had two days to respond, at which time Mr. Long released the funds to the buyer.

For all other disputes, Mr. Long would give the respondent ten days to submit a written response or counterclaim. Mr. Long then would decide based on a preponderance of the evidence. He provided several default rules, though these rules could be superseded by a documented agreement between the buyer and seller made at the time of sale. Default rules included that the "seller had fully performed should the physical goods be delivered to the provided destination in a condition that conforms with the agreement" and that "if the seller ships an incorrect item, buyer has no duty to return said item until seller refunds buyer the entire purchase price and provides or pays for return shipment."

V. How OpenBazaar's Method of Dispute Resolution Compared to Traditional Government and Private Enforcement Mechanisms

OpenBazaar's multisignature-escrow approach differed from the more traditional methods to combat fraud and enforce contracts: ex post legal enforcement and ex post private enforcement. Most people think of contracts as being enforced by the legal system. If one party to a contract feels that another party has breached its terms, they can file motions, with all that implies: retainers, attorneys, judges, negotiation, the prospect of settlement, and in some cases trial. Each stage is governed by human decisions and enforced by the coercive power of the state: if a party does not abide by the court's verdict, they may face the threat of greater punishment.

An alternative to the government legal system is ex post enforcement by private parties. Payment processors and

intermediaries such as PayPal and eBay decide many contractual disputes privately (PayPal 2018a). A PayPal buyer, for example, may open a dispute against a seller of a physical good for two reasons: “Item Not Received” and “Significantly Not as Described.” If buyer and seller cannot resolve the matter by themselves, the dispute is escalated to a claim, to which the seller has ten days to respond, at which point PayPal arbitrates the claim. Payment processors such as PayPal also incentivize sellers to use carriers that provide documentation and to adopt other best practices by offering protection against credit card chargebacks.

Table 1 compares the three methods across several attributes and describes possible limitations of each. The methods become increasingly decentralized as one moves from left (ex post legal) to right (multisignature escrow), with the second (ex post private) and third (multisignature escrow) being private, voluntary methods.

Table 1. Three Methods of Enforcement

	Ex post legal	Ex post private	Multisignature escrow
Example	US court system	PayPal	OpenBazaar
Source of authority	Monopoly on coercion	Access to platform (potential legal action)	Smart contracts (precommitment to outcome)
Scope for punishing fraud	Civil remedies	Access to platform (potential legal action)	Limited by algorithm to price of the item
Specialization of third party	By court	By platform	By buyer and seller
Common rules and procedures	Jurisdiction (all cases including retail fraud)	Platform (retail fraud only)	Individually selected mediator
Reversibility of fraud	Coercive, subject to appeal	Under platform control	Requires buyer's signature and one other
Scope for appeal	Court decision	Under platform control	None
Cost to defrauded party	Legal costs	Cost of initiating claim	Cost of mediation
Deadline for detecting fraud	Statute of limitations	180 days	Specified by selected mediator
Scalability	Theoretically high, but poorly matched to low-value disputes	High	Theoretically high
Third-party incentive issues	Political	Encouraging repeat business from large sellers	Asymmetric information, potential collusion with mediator

Who is in control of each system? A governmentally enforced contract relies on the threat of action by some central authority to ensure enforcement. Parties who do not abide by legal decisions in resolving contractual disputes face potential sanctions. PayPal, in contrast, has no authority to restrict freedom but does have authority over all funds in its network and can deny access to parties not abiding

by contracts. PayPal is ultimately still in control. Multisignature escrow is unique because it does not rely on a single authority or intermediary. With OpenBazaar there was no central intermediary to move funds, make a credible threat to ban a party from the platform, or even know the identity of each party. The potential of multisignature escrow to substitute for a central authority by simply forcing parties to commit to resolutions before the transaction begins is striking.

How is fraud dealt with and punished? In the court system, a judge or jury can assign more severe punishments to a convicted fraudster than merely returning funds to the rightful party. These include civil damages and fines. PayPal does not hand out jail time as may a court, restricting future access to its system serves as a form of punishment. In contrast to both of these systems, multisignature escrow is restricted by its algorithm to only return funds to their rightful owner.

How long does one have to figure out that fraud occurs? Not all fraudulent transactions are immediately detectable. Suppose that a seller knowingly sends a buyer a laptop computer with a depleted or defective component that fails after a short period of usage. The ex post legal approach depends on the statute of limitations governing the transaction. Under PayPal's private enforcement system, claims must be filed within 180 days (PayPal 2018b). OpenBazaar did not specify a window, leaving it open to the parties to choose. An advantage of decentralized rulemaking is the tailoring of the window of time within which parties can dispute the quality of a transacted item ex post facto, which brings about efficiencies for the markets and transacting parties alike.

What rules and procedures are followed? In theory, courts can handle even the smallest disputes—small-claims courts are designed especially for such matters—but in practice civil-procedure rules are clunky for dealing with them and in any event not catered to disputes on a single platform. A system like PayPal, in contrast, can adjudicate disputes on its own platform far more inexpensively and efficiently than the courts because cases do not have to leap over procedural hurdles or compete for room on a docket. On a network like OpenBazaar, each third-party mediator had his or her own pre-stated rules and areas of expertise. Mediating a dispute about product quality might be significantly different for vintage baseball cards, flower seeds, and cigars. This, of course, is vastly different from modern civil procedure, in which the Federal Rules for Civil Procedure arose explicitly to treat the underlying claims agnostically in the interest of expedience and uniform justiciability.

Are victims made whole? A court can either punish the fraudster, which does not really help the victim, or mandate return of funds and possibly some extra damages. Even if funds are fully returned, the victim of fraud still incurs costs under any system. Ex post legal enforcement involves significant costs including legal fees, time until judgment, and compliance with bureaucratic hurdles. Private enforcement and multisignature escrow typically involve lower costs for fraud victims since the dispute processes can be customized according to the specific nature of the transaction in question.

Can a party appeal? Under both legal and private ex post enforcement, losing parties have an opportunity to appeal that is ultimately decided by the court or private entity. But because of the irreversibility of Bitcoin transactions, in multisignature-escrow systems such as OpenBazaar there is no immediate scope for a losing party to appeal. In theory, appeals could be coded into multisignature-escrow code in any way developers want, but in practice the lack of recourse (sometimes disparagingly described by attorneys as “another bite at the apple”) distinguished OpenBazaar’s approach from the other two approaches. OpenBazaar was hardly the first place where, all considerations factored in and despite the best intentions, justice is occasionally not served.

In terms of scalability, government courts and PayPal’s private dispute-resolution system both handle many widely varying cases. Could OpenBazaar’s decentralized multisignature-escrow approach have grown along with the platform? While court cases can and often do incur significant costs, costs per case do not necessarily increase with the number of cases handled. Given the large number of transactions processed by PayPal, it is not surprising that its private dispute-resolution system appears highly scalable. It involves many similar cases, applying standardized procedures within a centralized framework. As transactions increased, the OpenBazaar system might have required an ever-larger number of third-party mediators or consumed ever more of existing mediators’ time. An increased demand for mediator services could have resulted in higher fees, possibly making the decentralized platform costly or inefficient relative to existing centralized retail platforms such as eBay and payment platforms such as PayPal.

VI. Efficacy of Multisignature Escrow in Preventing Fraud

All three systems seek to prevent fraud by lowering the expected payoffs associated with such activity. To protect against seller fraud in traditional e-commerce, buyers rely either on the reputation of a large retailer such as Amazon or a large, centralized platform such as eBay or Etsy. Decentralized platforms such as OpenBazaar can only succeed if they are effective enough in preventing the types of fraud mostly likely to occur.

The commitment requirement of multisignature-escrow systems forces both buyers and sellers to accurately signal their intention not to commit fraud, yet this happens only if the underlying mediation process is sufficiently reliable and accurate. Multisignature escrow allows buyers to signal they will not commit fraud since they risk losing their funds in the mediation process. The system could break down if a buyer wishing to commit fraud calculates a high-enough probability of misleading the mediator. Mediators can to some extent mitigate that risk, in turn, by encouraging transacting parties to apply best practices that fully document both the condition of a sale item and the terms of shipment.

Subjective issues such as product quality complicate the mediation system. To the extent that a good being bought or sold must meet certain specifications to prove functional, or its value hinges upon subjective assessments, adequate mediation may require expertise that is not necessarily part of the selected mediator's skill set. Consider the sale of a rare book: Grading such an object may be highly subjective and even change over time. A seller offering a book as F- (fine minus) may be challenged by the purchaser who, upon closer inspection, views the book as VG+ (very good plus)—a close, but different, classification. Here there is likely no attempt to mislead or swindle, but rather an objection based upon qualitative elements. (Indeed, even experienced, expert bookdealers disagree at times on the proper grading of a scarce book, manuscript, or incunabulum. And this applies to many more collectibles than just books.)

The asymmetric information inherent in the process—individuals know whether they intend to commit fraud but not whether their trading partners do—coupled with the irreversibility of blockchain transactions creates a complex web of incentives in the mediation process.

Some OpenBazaar buyers reported falling victim to collusion attacks, in which a seller and moderator cooperated or the seller created a second identity as a moderator on the network (OpenBazaar

2018). In the latter case, when the buyer's funds went to the multisignature-escrow address at the time of purchase, the seller and moderator both immediately signed to release funds to the seller, who never delivered the promised item. In response to these scams, OB1 created a mediator-verification program in early 2018. The program used the identity-verification service Keybase, which maps social media accounts to encryption codes. Buyers and sellers could check the Keybase identity on the mediator's OpenBazaar page, and mediators could maintain a degree of anonymity if they chose to.

Other potential incentive problems in the mediation process remained. Jacob Ian Long, whose mediation policies were described in section 4, reports having mediated only a small handful of disputes. One mediator we interviewed hypothesized that one of the reasons he did not see more disputes was that, because of his rigorous policies and strong reputation in the OpenBazaar community, only the most honest and reliable sellers selected him as a mediator.

A detailed, decentralized reputation-scoring system for mediators, long discussed in the OpenBazaar community (OpenBazaar 2015), could help mitigate these problems. Both buyers and sellers could rate mediators after disputes on timeliness, fairness, and accuracy. Such a system would not only aid both parties in selecting mediators but also bring greater trust to the entire system. By selecting only mediators with high reputation scores, sellers could signal to buyers their intention to be honest, potentially putting scammers (and dishonest mediators) out of business.⁶

VII. Conclusion

Multisignature-escrow technology, a type of smart contract, represents a novel solution to the problem of fraud in contexts in which transacting parties do not interact face-to-face or do not plan on interacting subsequently. It allows the parties to a transaction to precommit to the execution of a contract if certain criteria are met. OpenBazaar was an early application of multisignature-escrow technology, a decentralized market in which anonymous buyers and sellers agreed in advance of a transaction to be bound to the decision of a third-party mediator in the event of a dispute.

Comparing the structure and incentives of OpenBazaar's multisignature-escrow system to other existing public and private approaches to fraud prevention demonstrates its potential use as an

⁶ For a formal presentation of signaling, see Spence (1973).

efficient and effective way to prevent and address controversies. Yet multisignature escrow requires a human layer in the form of occasionally invoked third-party mediators. This is beneficial in terms of the system's flexibility, but its benefits hinge on the mediators' ability to reliably reach correct decisions.

This decentralized marketplace was of considerable potential value. By most accounts the multisignature-escrow system served its purpose in preventing market participants from being the victims of fraud and in providing satisfactory recourse to those who were. When asked what went wrong, OpenBazaar project lead Brian Hoffman said, "First, we should have spent much more time on some kind of web version, or focused solely on mobile. We spent too much time building a complicated, high-maintenance desktop application." And "we should have also figured out a way to add stablecoin support for the marketplace. That would have created price stability and mitigated the volatility that inhibited people using the e-commerce platform" (Hochstein 2021). Most importantly his firm lacked a good way to monetize use of the platform. OpenBazaar posted all of its code as open source, and as of 2022 a new version—Mobhaza—exists that bills itself as "a free online marketplace, derived from Openbazaar." Another online seller describes itself this way: "In fact, the structure of this store is similar to Openbazaar. The structure is as simplified as possible. Escrow and smart contracts are compensated by reputation." More broadly OpenBazaar is influencing smart-contract technology in general. Hoffman stated, "We were one of the first truly decentralized applications (dapps) for crypto before there was even a name for it" (Hochstein 2021). Just as Zenith, Magnavox, and RCA no longer exist as American electronics corporations but their influence lives on, we believe that elements of OpenBazaar's decentralized contract-enforcement setup will influence marketplaces in the future.

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