



Annual Review of Sociology

Online Illegal Cryptomarkets

Dana L. Haynie¹ and Scott W. Duxbury²

¹Department of Sociology, The Ohio State University, Columbus, Ohio, USA; email: Haynie.7@osu.edu

²Department of Sociology, The University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA; email: duxbury@email.unc.edu

Annu. Rev. Sociol. 2024. 50:31.1–31.20

The *Annual Review of Sociology* is online at
soc.annualreviews.org

<https://doi.org/10.1146/annurev-soc-090523052916>

Copyright © 2024 by the author(s). All
rights reserved

Keywords

illegal markets, cryptomarkets, trust, networks, technology, drugs

Abstract

Cryptomarkets—online markets for illegal goods—have revolutionized the illegal drug trade, constituting about 10% of all drug trades and attracting users to a greater variety and more addictive substances than available in offline drug markets. This review introduces the burgeoning area of sociology research on illegal cryptomarkets, particularly in the realm of drug trade. We emphasize the expanding role of illicit online trade and its relevance for understanding broader exchange challenges encountered in all illegal trade settings. Examining the effects of online illegal trade on consumption and supply-side policing, we also discuss the harm and potential benefits of moving drug exchange from offline to online markets. We argue for a network perspective's efficacy in this research domain, emphasizing its relevance in assessing trade and discussion networks, technical innovation, and market evolution and vulnerabilities. Concluding, we outline future research areas, including market culture, failure, and the impact of online illegal trade on stratification.



INTRODUCTION

Illegal markets have long captured public and scholarly attention. Foundational work in sociology and criminology highlighted illegal markets as central to the reproduction of crime in specific spatial areas (Cloward & Ohlin 1960, Shaw & McKay 1942). Such markets are vital income sources for disadvantaged groups with limited access to legitimate employment (Beckert & Wehlinger 2013, Merton 1937), and they also serve as revenue streams for organized crime, resulting in downstream consequences for offending and victimization (Bouchard & Wilkins 2009, Caulkins & Reuter 2010, Venkatesh 1997). Moreover, illegal drug markets substantially impact health outcomes, as drug overdose mortality rates tripled between 2000 and 2016 (Hedegaard et al. 2017) and have been a key driver of “deaths of despair” among working-class white men (Case & Deaton 2020). The economic implications are also substantial: In 2010, combatting illegal drugs accounted for 1% of the United States gross domestic product (Kilmer et al. 2014). Understanding the consequences and dynamics of illegal markets is essential for shedding light on how market actors assign value, fulfill trade obligations, and develop from nascent stages into stable trade networks.

One of the most notable transformations in illegal trade over the past two decades has been the proliferation of online illegal markets, often called cryptomarkets.¹ Recent technological advances have facilitated the development and flourishing of online illegal markets on the dark web, fundamentally reshaping the landscape of illicit trade and granting unprecedented access to prohibited goods (Aldridge & Décary-Héту 2016, Barratt 2012, Barratt & Aldridge 2017). Just as the Internet revolutionized legal trade through platforms like eBay (Diekmann et al. 2014), reshaped political discourse through microblogging sites like Twitter (Perrin 2014), and transformed social networks through platforms like Facebook (Hofstra et al. 2017, Lewis et al. 2008), it has also restructured illegal trade through the emergence of online illegal markets.

In this review, we provide an overview of the expanding body of research on online illegal markets, focusing on the domain of illegal drug trafficking since drugs constitute a significant portion of illicit goods sold on cryptomarkets. We commence by delineating the nature of online illegal markets and their distinctions from traditional offline markets. Subsequently, we delve into the dynamics and implications of these markets for crime and criminal innovation, crime control and policy, and social norms and behaviors linked to drug use, as well as public health and public policy. Additionally, we explore the distinctive implications of cryptomarkets for market exchange, spotlighting emerging research within economic sociology that pertains to online illegal markets. We also highlight the relevance of adopting a network perspective for comprehending online illegal trade. Concluding, we discuss the pathways for future research and stress the need for collaboration between scholars, law enforcement agencies, and policymakers to prioritize sociological research, ensuring a comprehensive and well-informed response to the intricacies and ongoing evolution of online illegal markets.

BACKGROUND

Cryptomarkets predominantly serve as platforms for illegal drug transactions, providing a secure and anonymous environment for buyers and sellers to conduct business easily and discreetly using cryptocurrency, a digital currency that ensures user anonymity (Barratt & Aldridge 2017, Christin 2013). The watershed moment arrived in 2011 with the launch of Silk Road, the first and most infamous cryptomarket, heralding a new era in drug distribution. Subsequent to its closure in 2013, many other cryptomarkets emerged, learning from past experiences and continually innovating to

¹ We focus primarily on markets operating on the dark web, as these markets have been the most widely studied type of online illegal market and account for a growing share of all online illegal trade.

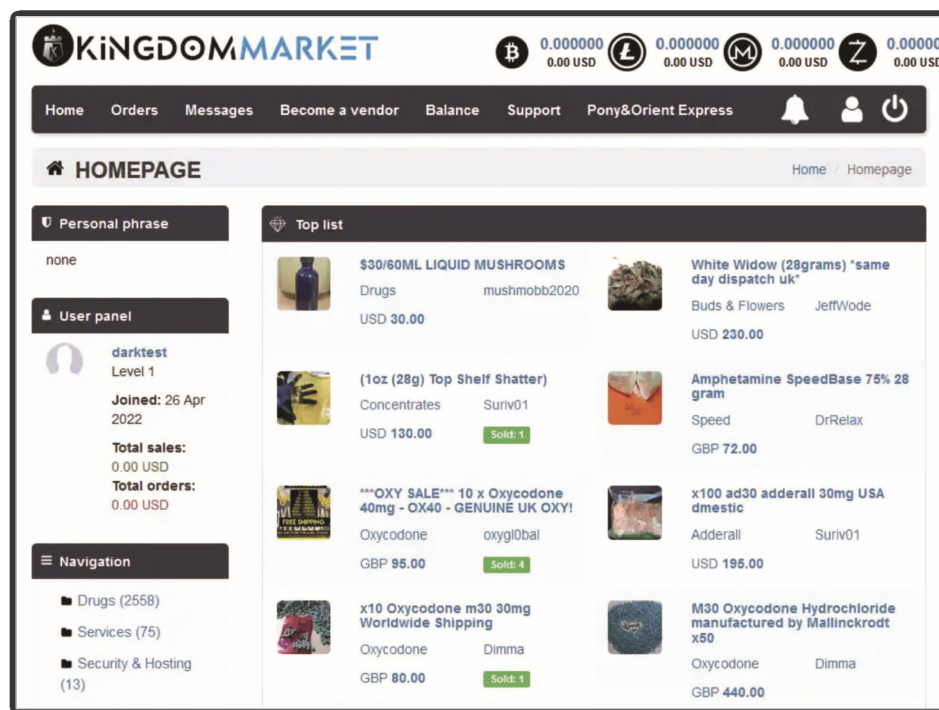


Figure 1

Screenshot of the landing page of an online illegal market.

evade law enforcement. These markets now offer a vast array of illegal goods and attract a much larger clientele. Some current markets generate more than \$US 500 million in annual revenue, and contemporary estimates suggest that online drug markets already contribute to over 10% of all global drug trade (UN Off. Drugs Crime 2021).

The interface of an online illegal market resembles legitimate online marketplaces like eBay and Amazon. Users access these markets on the dark web using the Tor browser, which masks their location and browsing history. Once within the markets, users encounter listings for drug products, links to discussion forums, and other website information (Figure 1). Each product listing includes feedback from previous purchasers, comprising written comments and numerical ratings reflecting their satisfaction with the vendor and the transaction. In many markets, completing numeric evaluations is a prerequisite to finalizing a transaction, although buyers may have the option to revise their assessment following product receipt. Upon making a purchase, goods are delivered to the buyer through agreed-upon channels. For instance, details are usually transmitted via direct messaging or decentralized peer-to-peer communication. Physical goods, like drugs, are generally dispatched via governmental postal services to the buyer's designated address or other specified locations, such as secure public lockers and post office boxes.

Online illegal markets differ significantly from traditional offline markets in terms of access, reach, risks, pricing, and vulnerabilities. While traditional illegal markets operate in physical locations, where face-to-face interactions occur between buyers and sellers, online illegal markets span geographic boundaries and can cater to a global customer base. Although online trade also shields market actors from physical risks, like violence, robbery, and police raids (Décary-Héty & Dupont 2012), it imparts new risks such as cyberattacks and fraudulent activities (Aldridge & Décary-Héty 2016). Moreover,

online markets afford greater anonymity to both buyers and sellers, complicating law enforcement efforts to trace and identify participants (Décary-Héту & Dupont 2012). Consequently, buyers now possess global access to a diverse range of illegal drugs available with a mere mouse click.

The diversity of products and of pricing further distinguish the two market types. The digital nature of online illegal markets permits a broader spectrum of illegal products and services to be offered (Décary-Héту & Dupont 2012). Vendors can offer an extensive selection of drugs, counterfeit items, hacking services, weapons, and other illicit goods and services (Aldridge & Décary-Héту 2016). In contrast, offline markets are constrained by the availability of goods within their geographic location (Bushway & Reuter 2008, Caulkins & Reuter 2010). Pricing within online markets also tends to be more uniform due to global vendor competition, while offline markets are influenced by local demand and supply dynamics, resulting in varying prices and localized competition (Bushway & Reuter 2008). Illicit products listed online generally command higher prices than their counterparts in offline illegal markets (Moeller et al. 2021, UN Off. Drugs Crime 2021), consequently attracting relatively more affluent online drug buyers (Barratt et al. 2014).

Given the relative anonymity inherent in online drug trade, law enforcement faces distinctive challenges in dealing with online illegal markets. Traditional policing methods like surveillance and raids can disrupt offline markets more readily, and they are also vulnerable to territorial disputes between rival gangs (Décary-Héту & Dupont 2012). Conversely, tracking online illegal transactions and identifying market participants necessitates specialized skills and tools for effective intervention. Although more immune to traditional policing strategies, online illegal markets have their own set of vulnerabilities, including cyberattacks, vendor exit scams, and technological disruptions, which may impede market operations (Aldridge & Décary-Héту 2016).

CONSEQUENCES OF ONLINE ILLEGAL TRADE

The transformation in online illegal markets has yielded consequences that extend far beyond the transactional websites themselves. Below, we delineate these consequences, addressing their implications for understanding crime and criminal innovation, crime control and policy, social norms and behaviors linked to drug use, and public health and public policy. Throughout, we underscore the unique research prospects that studying online illegal markets presents.

Crime and Criminal Innovation

The emergence of online illegal markets constitutes a significant criminal innovation in illicit trade, with wide-reaching implications for crime and its regulation (Aldridge & Décary-Héту 2016, Ladegaard 2020). Encrypted communication channels, such as Tor, provide anonymity for buyers and sellers, while cryptocurrencies enable nearly untraceable financial transactions (Barratt & Aldridge 2017). The decentralized nature of cryptocurrencies complicates investigative efforts, given the absence of a central authority overseeing transactions or user identities. Consequently, law enforcement faces considerable challenges in identifying and prosecuting those involved in online illegal trade.

The ascent of online illegal markets has also revolutionized retail practices among drug distributors and reshaped the structure of drug supply chains, with mid-level retailers increasingly procuring and distributing illegal goods exclusively through online platforms (Aldridge & Décary-Héту 2016). These online platforms help shield mid-level retailers from violence and intimidation inherent in competing with established hierarchical criminal organizations controlling geographic turf (Barratt et al. 2016, Martin et al. 2020). This has led some online drug distributors to accept diminished profit margins to avoid direct entanglement with criminal organizations engaged in offline illegal trade. This evolution has also disrupted certain drug supply chains, as mid-level retailers can now distribute directly to individual drug users as well as smaller wholesale distributors (Aldridge & Décary-Héту 2016).

While research is just beginning to unravel the intricacies of these markets' criminal innovation, further research is essential for comprehending the interplay between evolving encrypted communication channels like Tor and the countermeasures employed by law enforcement. Such an exploration could elucidate strategies to counteract identity obfuscation and enhance investigative capabilities. Likewise, a deeper examination of cryptocurrency-based transactions' vulnerabilities and potential disruptions may offer insights into curtailing untraceable financial flows that underpin online illegal markets. Furthermore, understanding the nuanced motivations of mid-level retailers who choose to operate within these digital spaces and exploring the extent to which they remain detached from traditional criminal organizations could illuminate novel avenues for crime prevention and intervention strategies.

Crime Control and Policy

Online illegal markets present unique challenges for supply-side policies, as they exhibit resilience against local elasticities that often trigger fluctuations in pricing and product availability in offline illegal markets (see Becker et al. 2006, Bushway & Reuter 2008). As a result, online markets provide a means for accessing illegal goods even when supply-side policies attempt to limit local availability. An illustrative example of this phenomenon occurred in 2014 when the US Drug Enforcement Administration reclassified hydrocodone, a prescription opioid, from a schedule III substance to a more tightly regulated schedule II substance. Martin and colleagues (2018) analyzed the impact of this policy shift on dark web opioid trafficking. Their findings revealed an initial short-term increase in hydrocodone sales on the dark web due to the change in scheduling status. However, over time, the surge in hydrocodone sales was replaced by a long-term increase in fentanyl and heroin sales as former hydrocodone users shifted to cheaper and more potent opioids.

The adaptability of online illegal markets to supply-side policy changes complicates traditional drug control approaches. A recurring theme in research on online illegal markets is the ineffectiveness of conventional policing tactics. Given the decentralized nature of online trade, approaches such as arresting influential figures are neither practical nor likely to disrupt market operations (Duxbury & Haynie 2018a, 2020). Policing interventions that shut down multiple markets simultaneously have minimal effects on overall drug trafficking levels, as they tend to produce large influxes of traffic to still-operational markets (Ladegaard 2020, Norbutas et al. 2020, Ouellet et al. 2021). Consequently, while large-scale policing interventions may reduce crime in offline illegal markets (Braga et al. 2019, Weisburd et al. 2017), online disruptions tend to displace illicit trade rather than deter it.

The global nature of cryptomarkets further complicates enforcement efforts as illicit transactions transcend international borders (Barratt & Aldridge 2017). The absence of uniform laws and regulations about cryptocurrencies and the dark web across different jurisdictions creates coordination hurdles for international law enforcement, hampering individual countries' abilities to regulate them effectively (Christin 2013). Moreover, cryptomarkets continuously evolve and adapt, employing sophisticated security measures and communication protocols (Ladegaard 2020, Martin 2014), demanding specialized expertise to keep pace with technological advancement, posing additional challenges for law enforcement.

Given these intricate dynamics, the evolving landscape of online illegal markets necessitates fresh avenues of research to shape effective crime control and policy strategies. Future inquiries might explore technology-driven approaches to target supply-side disruptions in digital illicit trade, seeking innovative means to counteract the adaptive nature of online markets. Examining the efficacy of cross-jurisdictional collaboration and establishing international frameworks for regulating cryptocurrencies and the dark web could provide insights to enhance global enforcement efforts. Moreover, a holistic understanding of the interplay between market displacement effects and the potential for deterrence in

online illegal markets is essential for crafting policies that mitigate unintended consequences and effectively curtail illicit trade within the digital realm.

Social Behavior and Norms About Drug Use

Cryptomarkets can shape social behaviors, norms, and values associated with drug use (Van Hout & Bingham 2014). The proliferation of online illegal markets has expanded access to illicit goods, leading to shifts in drug consumption patterns (Barratt et al. 2016b, Van Hout & Bingham 2014). Notably, approximately 11.3% of respondents polled by the Global Drug Survey (Winstock et al. 2021, p. 26) indicated purchasing drugs from cryptomarkets on the dark web.

The capacity of online illegal markets to transcend geographic boundaries has enhanced the accessibility of illicit goods. Buyers are drawn to online platforms due to convenience and perceived safety compared with traditional street-level drug markets (Van Hout & Bingham 2014). Online platforms also provide access to substances and other goods unavailable through offline channels (Barratt et al. 2016b). Reports from online drug buyers reveal more frequent drug purchases, a greater diversity of drug products purchased, increased drug experimentation, and more harmful drug use (Barratt et al. 2016b, Martin et al. 2018, Van Hout & Bingham 2014, Walsh 2011). Furthermore, online drug buyers report increased “drug hoarding,” involving acquiring substantial drug quantities in single transactions for extended use (Barratt et al. 2016b), potentially prompting changes in drug consumption (UN Off. Drugs Crime 2021, p. 24).

Future research should explore the complex interplay between online illegal markets and drug consumption patterns to comprehensively understand evolving social behavior and norms linked to drug use. Exploring the multifaceted impact of increased accessibility to illicit goods on individual behaviors, attitudes, and health outcomes, as well as the role of online platforms in shaping perceptions of safety and convenience, could provide crucial insights for designing targeted interventions and harm reduction strategies. Examining the relationship between the diversity of available substances and drug experimentation, as well as the consequences of increased drug hoarding and changes in consumption, can help policymakers and public health experts anticipate and address emerging challenges in this evolving landscape.

Public Health and Policy Implications

Online illegal drug markets present risks and benefits to various stakeholders, with profound implications for public health and policy (Cunningham et al. 2018). The anonymity and convenience of online drug purchasing may attract new users who might not have otherwise engaged in drug use. The wide range of substances available on these platforms can contribute to drug experimentation, polydrug use, hoarding, and intensified substance use (Barratt et al. 2016b, Martin et al. 2018), potentially leading to increased overdoses and addictions (Van Hout & Bingham 2014). Additionally, the presence of counterfeit pharmaceuticals on these platforms poses significant risks to public health, as consumers may unknowingly purchase adulterated or ineffective medications. The absence of quality control and regulation in the illicit drug market raises further concerns about the purity and safety of substances purchased from cryptomarkets.

Despite the substantial negative consequences of online illegal trade, some scholars have highlighted certain social benefits that online illegal markets offer compared with their offline counterparts. One potential advantage lies in heightened transparency in the quality of goods and the possible reduction of product contamination through open product evaluation (Aldridge et al. 2018, Bancroft & Reid 2016, Barratt & Aldridge 2017). Another potential benefit arises from the reputation-based feedback system employed by cryptomarkets, which serves as a form of quality control. Vendors on these platforms are incentivized to deliver high-quality products and services to maintain positive

reputations (Aldridge et al. 2018). This dynamic can result in higher customer satisfaction compared with street-level drug markets, where product quality and consistency may vary due to the lack of such feedback mechanisms and the existence of monopolistic competition that limits organizational incentives to offer better products (e.g., Beckert & Wehlinger 2013, Gambetta 2009).

Additionally, online drug trade might reduce violence in drug transactions by minimizing direct interactions between buyers and sellers (Martin 2014). Some researchers even suggest that online illegal markets could reduce organized crime violence (Barratt et al. 2016a), as online illegal trade reduces incentives for territorial control, given that geographic monopolies are unnecessary to secure market shares (e.g., Caulkins & Reuter 2010, Papachristos et al. 2013). As a result, revenue is diverted away from violent organizations, such as street gangs, competing for local and regional influence.

Future research should delve into several critical areas to comprehensively address the intricate public health and policy implications arising from online illegal drug markets. Investigating the impact of increased accessibility to diverse substances on drug experimentation, polydrug use, and the potential escalation of harmful behaviors is paramount for designing targeted interventions and harm reduction strategies. A crucial focus should be on understanding the extent of health risks, including overdoses and addictions, attributed to the availability of more potent substances and the lack of quality control in this digital landscape. Research aimed at identifying and curtailing the sale of counterfeit pharmaceuticals on these platforms could provide actionable insights for safeguarding public health. Moreover, further research is needed to unravel the intricate balance between potential social benefits and negative consequences of online illegal markets. Examining the dynamics of the reputation-based feedback system and its impact on enhancing product quality and consumer satisfaction could offer valuable lessons for improving drug market operations. Investigating the extent to which online drug trade reduces violence and organized crime and understanding the mechanisms behind these potential reductions could guide policy efforts to foster safer drug market environments.

In summary, prior studies have outlined how online illegal markets lead to profound yet intricate consequences for illegal trade. These markets influence drug use frequency, diversity, and potency while curbing violence and product contamination in offline trade realms. They have also reshaped supply chains and complicated the effectiveness of supply-side policing tactics. The contrasting effects of cryptomarkets underscore the necessity for future research to examine online drug markets' impact on health outcomes and the broader drug epidemic in order to shape effective public health policies and interventions on morbidity and mortality among online drug buyers relative to their offline counterparts.

MARKET ORGANIZATION AND TRADE DYNAMICS

To effectively engage in the emerging research directions described above, it is essential to understand the intricacies of market organization and trade dynamics within these platforms. Like traditional on-the-ground markets, cryptomarkets face coordination problems in organizing exchanges (Beckert 2009). However, these challenges are amplified in the context of online illegal trade, where market actors grapple with issues such as information asymmetry (Akerlof 1970), anonymity (Granovetter 1985), and the risk of state sanctioning (Gambetta 2009). Actors within these markets thus struggle to ensure cooperation, assign value to illegal goods, and compete without the oversight of governing authorities (Beckert & Wehlinger 2013). While online actors are insulated from physical violence, they also lack the recourse to employ violence or intimidation to promote cooperation, a common enforcement mechanism in offline illegal trade (Caulkins & Reuter 2010).

Consequently, trust evaluations take on paramount importance. Placing trust in the wrong exchange partner can lead to financial loss, physical harm, and health hazards in the case of drug distribution. Market actors face a dilemma when deciding whom to trust within online illegal markets. In traditional

drug markets, reputation and trust are forged through direct interactions and reliance on personal social networks, shared social connections, kinship, and circulating information about actors' past trade practices (Beckert & Wehlinger 2013, Bright et al. 2018, Gambetta 2009, Smith & Papachristos 2016). However, the traditional role of networks is undermined in online settings due to actor anonymity, rendering interpersonal connections, shared social attributes, and network-mediated information dissemination ineffective (Bakken et al. 2018, Diekmann et al. 2014, Kollock 1999, Ladegaard 2020, Przepiorka et al. 2017).

The most widely discussed trust mechanism in online illegal trade settings is the reputation-based feedback system, analogous to feedback systems employed on platforms like eBay or on review aggregators like Yelp. The reputation-based feedback system plays a pivotal role in establishing trust, reducing the risk of fraudulent transactions, and enabling self-policing within the market system (Diekmann et al. 2014, Duxbury & Haynie 2018b, Kollock 1999, Ladegaard 2020, Przepiorka et al. 2017). Reputation is built through numeric sales ratings submitted by previous buyers, enabling prospective buyers to assess the quality of past transactions (Bakken et al. 2018, Barratt et al. 2016a, Cox 2016, Van Hout & Bingham 2014). Buyers can rate vendors and offer feedback based on their experiences, aiding future buyers' ability to gauge reliability and product quality.

Multiple studies underscore the close attention potential buyers pay to formal reputational systems (Bakken et al. 2018, Barratt et al. 2016b, Cox 2016, Van Hout & Bingham 2014). Przepiorka and colleagues (2017) find that increases in reputational standing are associated with increases in sales volume and prices, while Munksgaard & Tzanetakis (2022) find that reputational standing is associated with stronger revenue generation. Conversely, negative feedback can have adverse effects, limiting repeat purchases, deterring future customers, and potentially risking vendor expulsion from the market (Munksgaard & Tzanetakis 2022, Przepiorka et al. 2017). This reliance on high-reputation vendors contributes to a more centralized market structure where buyers flock to high-reputation vendors (Duxbury & Haynie 2018b), creating substantial market barriers for new vendors without established reputations to gain a foothold.

Reputational information incentivizes vendors to uphold ethical business practices and maintain high standards of service and product quality (Barratt & Aldridge 2017). Successful vendors closely monitor market trends and customer feedback, adjusting their strategies to remain competitive. Moreover, maintaining operational security and avoiding police detection are also crucial success factors for cryptomarket vendors (Martin et al. 2020). Given law enforcement's efforts to disrupt these markets, vendors must adopt stringent security measures and remain vigilant against potential threats.

While essential, the reputation system in online illegal markets also has several limitations that researchers have highlighted. A primary concern revolves around the potential for fake reviews and biased feedback, whereby vendors or competitors attempt to inflate their reputation or denigrate others to gain an advantage (Masson & Bancroft 2018). For instance, studies have revealed instances of sales padding, where vendors purchase goods from themselves to leave positive reviews, inflating their reputation (Cox 2016). Fear of retaliation may also hinder honest feedback, as some buyers may hesitate to leave negative reviews (Van Hout & Bingham 2014). The mandatory nature of sales evaluations can inflate reputations, as buyers often leave five-star reviews to avoid angering vendors before the completion of the transaction and later neglect to update their feedback after receiving the product. This phenomenon has led to a bimodal distribution of sales ratings, with a high prevalence of five-star evaluations (Przepiorka et al. 2017, Tzanetakis et al. 2016). Other studies suggest that reputational effects may be limited to first-time buyers, who utilize reputational information for their first transaction but rely on other factors, such as pricing and networks, for subsequent trade (Duxbury & Haynie 2018a, Norbutas et al. 2021).

In summary, trust-related concerns assume a central role in online illegal drug trade as buyers and sellers navigate conditions marked by anonymity, significant information asymmetry, financial and health risks, and the specter of state intervention. Reputational mechanisms facilitate trade under these circumstances, albeit with varying degrees of effectiveness, primarily affecting new buyers. While reputation systems are integral for market stability, recent research also notes the important role of network structure for shaping market outcomes beyond that offered by the reputation system. Turning to this issue, we next describe an emerging strand of economic sociology research that highlights the importance of network dependencies in facilitating online illegal trade, even within an environment marked by relative anonymity among market participants.

NETWORK GOVERNANCE AND THE ECONOMIC SOCIOLOGY OF ONLINE ILLEGAL MARKETS

Within online illegal markets, social relationships develop through economic and social interactions endogenous to the online trade environment. Economic trade networks shape actors' reputations and build trust. Adopting a network perspective reveals the interdependence of market actors and sheds light on the influence of network structures on market dynamics. This approach can identify influential actors and key clusters of actors involved in market governance and enforcement mechanisms (Décarry-Héту & Laferrière 2015). Network data also contribute to our understanding of market resilience and market actors' adaptive tactics in response to law enforcement efforts. For instance, market actors might resort to evasive tactics and migrate to more secure platforms to counteract law enforcement interventions. By examining the connections woven within online illegal drug cryptomarkets, we gain a more nuanced understanding of the complex interactions among market participants and their reverberations on the market's overall functioning.

Online Illegal Markets as Trade Networks

Cryptomarkets are complex systems influenced by various social, technological, and legal factors. The new economic sociology contends that social relationships mold economic actions and that social networks are essential in shaping market outcomes (Fligstein & Dauter 2007, Granovetter 1985). Such networks establish trust, familiarity, and allegiance between exchange partners, affecting market behaviors like pricing, trade frequency, and efficiency (Hillmann & Aven 2011; Uzzi 1996, 1997; Uzzi & Lancaster 2004). Networks also provide an assurance structure in risky trade environments, as they disseminate reputational information, establish trade norms, and cultivate prospects for future returns via ongoing trade relationships (Axelrod 1984, Greif 2006, Kollock 1994, Podolny 2001).

Despite a substantial body of research underscoring the significance of social networks in unregulated trade, encompassing premodern and illegal exchange (Beckert & Wehlinger 2013, Gambetta 2009, Greif 2006, Moeller & Sandberg 2019), research into online markets has cast doubt on the role of network dependency (Bakken et al. 2018, Diekmann et al. 2014, Przepiorka et al. 2017). The anonymity inherent to online illegal markets has been perceived as undermining the viability of network-based enforcement mechanisms. Nonetheless, even without exogenous social networks in offline markets, network governance still permeates online trade, facilitated through economic trade networks that mold actors' reputations and build interpersonal trust.

The prevailing approach to examining network dynamics in online illegal markets is through the reconstruction of trade networks using sales evaluations. Connections between buyers and vendors are established through weighted ties that reflect the number of illegal exchanges between a pair, thus generating an economic exchange network representing the frequency of illegal trade relationships. Early network analyses of online drug markets revealed densely clustered, localized patterns (Duxbury & Haynie 2018b). Preferential attachment to high-reputation vendors creates local clustering where

only a small share of buyers interlocks distinct communities (Duxbury & Haynie 2018a). Network-reputational effects have also been observed, whereby high-quality initial transactions engender recurrent exchange relationships, while poor-quality transactions prompt buyers to exit the market (Norbutas et al. 2021).

More recent studies highlight how trade network structures affect market outcomes by forging trust between exchange partners (Duxbury & Haynie 2021, 2023a). Two influential network mechanisms for cultivating trust are repeated exchange and four-cycle closure. Repeated exchange creates a sense of familiarity between partners, curtailing the costs of seeking new partners. Four-cycle structures emerge when two buyers purchase from the same two vendors, leading to indirect network referrals based on shared purchasing behavior (Duxbury & Haynie 2021, 2023a). Since online market actors pay close attention to sales histories when making purchasing decisions (Barratt et al. 2016b, Van Hout & Bingham 2014), four-cycle closure acts as an indirect network referral, where buyers interpret other buyers' shared purchasing behavior as an indicator of vendor trustworthiness and product quality.

Both network mechanisms wield substantial influence over market organization and trade dynamics. Network embeddedness in repeated exchange relationships and four-cycle structures empowers vendors to raise prices due to the trust premium in online illegal trade, where buyers are willing to pay higher prices to trade with trustworthy vendors (Duxbury & Haynie 2023a, Munksgaard & Tzanetakis 2022, Przepiorka et al. 2017). Additionally, these network effects have asymmetric impacts on product selection. Repeated exchange curtails the frequency of buyers purchasing new types of drugs, while four-cycle closure is associated with increased diversity in drug purchasing (Duxbury & Haynie 2023b). Repeated exchange relationships and four-cycle closure have also demonstrated a critical role in establishing trade relationships within emerging online illegal markets. In these contexts, reputational information is yet to be found through electronic feedback systems, compelling buyers to rely on trade networks for navigating online illegal trade during the precarious nascent stages of market development (Duxbury & Haynie 2021).

Embeddedness Paradox

While an expanding body of research documents the role of network dependence in online illegal markets, certain studies suggest that network governance can adversely affect market performance. Uzzi (1997) introduced the concept of the embeddedness paradox, describing situations where network dependencies diminish market efficiency. Over-embedded networks, characterized by exceedingly strong social ties, can dampen profit and competition by generating social incentives that override economic incentives. Buyers who harbor deep trust and loyalty towards specific vendors might secure discounts, thereby diminishing overall profitability and competitive dynamics within the market. Relying heavily on prior exchange partners can also lead to fragmented market structures resembling local monopolies, wherein few buyers seek out new vendors for illegal purchasing (Beckert & Wehlinger 2013).

In the context of online illegal drug cryptomarkets, overembeddedness is associated with lower drug prices and revenue. For instance, Duxbury & Haynie (2023a) identify a nonlinear effect of repeated exchange and four-cycle closure on the online drug trade, where overembedded networks are associated with lower drug prices and revenue. Moreover, such networks can contribute to market stagnation by undermining competition (Duxbury & Haynie 2023b). When buyers primarily purchase within local clusters or established trade relationships, it curtails opportunities for vendors to compete for customers and innovate. Consequently, overembedded trade networks have been shown to decrease the frequency of trade in well-established online drug markets (Duxbury & Haynie 2021).

Understanding the embeddedness paradox is essential for policymakers and law enforcement agencies seeking to address the challenges posed by online illegal trade. Hence, interventions that

tackle the complexities of online illegal markets must carefully consider the network dynamics and the potential implications of overembeddedness on market performance. By garnering a comprehensive understanding of network effects, policymakers can formulate more efficacious strategies to mitigate the repercussions of online illegal trade and safeguard public safety and health.

Open Discourse

The importance of open discourse in online illegal markets extends to shaping the dynamics and resilience of drug cryptomarkets. Venues for open discourse serve as platforms for market actors to exchange information, share insights and experiences, and evaluate vendors and products. This open exchange of information through encrypted channels allows actors to also discuss product quality, delivery methods, and best practices for consumption, fostering a community that is informed and well-versed in market intricacies (Aldridge & Askew 2017, Ladegaard 2020). Market actors gain insights into vendors' reputations, product reliability, and potential transaction risks by engaging in web-based discussion forums, direct messaging, and sales evaluations.

Kollock's (1999) early observations on eBay demonstrated how open discourse allowed vendors to build informal reputational standing, even before they had a formal reputation based on prior transactions. This phenomenon is also evident in the context of the online drug trade, where open discourse enables market actors to build and sustain reputations, foster transparent communication, and cultivate trust among fellow participants (Cox 2016, Morselli et al. 2018). Vendors can demonstrate their expertise, guide newcomers, transparently resolve trade disputes, and promote their products by engaging in discussions. Such interactions further foster relationships and trust within the market, contributing to developing a robust and resilient trading ecosystem.

Moreover, open discourse propels technical innovation in response to law enforcement interventions (Ladegaard 2020). Following policing operations, market actors often congregate on online forums to share information about the operation, identify vulnerabilities in website infrastructure, and leverage past experiences to enhance trading practices and website design. By learning from prior interventions and adapting their strategies, market actors have honed their ability to evade law enforcement efforts, augmenting the current online markets' resilience to future disruptions.

Network Vulnerabilities

Criminologists increasingly recognize the importance of adopting a network-oriented perspective to inform policing efforts (Bouchard 2007, Duxbury & Haynie 2019, McGloin 2005). Utilizing network metrics allows law enforcement to identify influential and highly connected actors within the market, such as brokers, who play crucial roles in facilitating transactions and coordinating trade. Targeting brokers can lead to more effective market disruption, particularly within the highly interconnected core of repeat purchasers (Duxbury & Haynie 2018a). However, traditional policing methods that disrupt drug cryptomarkets face formidable hurdles due to logistical complexities and resource constraints. Building criminal cases against market actors often spans years, necessitates cross-jurisdictional collaborations among law enforcement entities, and carries considerable expense. Moreover, large-scale policing operations have yielded limited success in significantly reducing market activity (Décarry-Héту & Giommoni 2017, Ladegaard 2019, Norbutas et al. 2020). These challenges have prompted some scholars to advocate for alternative policing tactics, such as trust-based policing (Duxbury & Haynie 2018a).

Trust-based policing undermines trust between market actors, thereby disrupting market activity. This could involve making modest purchases and subsequently leaving negative vendor reviews or patrolling online discussion boards like Dread, a dark web forum equivalent of Reddit, to post

unfavorable assessments of online vendors. The efficacy of trust-based policing hinges on resource allocation. Under resource constraints, interventions modestly diminishing vendors' reputations might prove more successful than arresting leading figures. However, at higher levels of intervention and with fewer resource constraints, the arrest of key figures can culminate in the complete closure of markets (Duxbury & Haynie 2020). By interpreting the dynamics of online illegal markets through a network-oriented lens, law enforcement can make more informed decisions and formulate targeted interventions to disrupt market activity effectively. Nevertheless, addressing the challenges posed by online illegal markets will persistently demand inventive and collaborative approaches from law enforcement agencies on a global scale.

Market Migration Networks

Another valuable network-oriented approach for understanding cryptomarket dynamics involves treating online illegal trade environments as migration networks (Norbutas et al. 2020, Ouellet et al. 2021). Treating markets as nodes and examining the connections between actors with active accounts on multiple markets provides insights into the transferability of reputation across markets and the displacement of actors following law enforcement interventions or other market disruptions. This approach also captures complex interdependencies within online illegal market ecosystems, offering a more comprehensive understanding of broader market dynamics. Research findings have revealed that vendors can uphold their reputational status even after market closure, as name recognition allows them to continue conducting business with the same clientele on other cryptomarkets (Norbutas et al. 2020). However, research using the migration network perspective has faced technical challenges due to the anonymity of market actors. Since actors can change their usernames on different markets, distinguishing whether a distinct username signifies a separate user or the same actor operating under a different identity becomes challenging. Consequently, researchers often restrict their analyses to a subset of actors who use the same username on multiple markets, limiting the scope of analysis.

Overall, the research into the network dynamics of online illegal markets has revealed that even anonymous actors can forge social connections through illegal trade and discursive interactions. The trade networks within these markets significantly influence various facets, encompassing buyers' purchase behaviors, vendors' sales strategies, and market resilience. Furthermore, this line of inquiry has contributed to a better understanding of offline illegal market conduct by underscoring the importance of economic trade networks in shaping market outcomes. While studies of offline illegal markets primarily concentrate on interpersonal networks (Beckert & Wehlinger 2013, Bright et al. 2018, Gambetta 2009), research into online illegal markets illustrates economic trade networks' impact on market outcomes. By delving into mechanisms related to trust, communication, and uncertainty, the research on online illegal markets has illuminated processes capable of influencing illegal market behaviors, both online and offline. This knowledge is invaluable for developing effective interventions and policies to tackle the complexities posed by illegal cryptomarkets.

FUTURE DIRECTIONS: CULTURE, MARKET FAILURE, MARKET INNOVATION, STRATIFICATION

Sociologists play a crucial role in studying how the anonymity and accessibility of illegal drug cryptomarkets influence drug consumption patterns and broader societal attitudes toward drugs and drug policies. The behavior of market actors is profoundly molded by social norms, trust networks, and informal rules that underlie their interactions. To understand cryptomarket activities comprehensively, researchers must consider the social context, interactions, and relationships among market participants. Embracing a sociological perspective allows for a deeper analysis of power dynamics, the configuration of trust networks, and the impact of social norms on market behavior.

This approach is vital for unraveling the complex interactions within these online illegal markets and their effects on drug use behaviors and social perceptions of such behavior. This next section outlines a few directions for future research on online illegal markets, spotlighting avenues that sociologists are well-equipped to pursue, including market culture, market failure, market innovation, and the repercussions of online illegal trade on social stratification.

Market Culture

Markets are not just economic entities; they are also cultural institutions shaped by status signals, cultural values, and trade norms (Fligstein 2001, Fourcade & Healy 2007, Podolny 2010). Initially, online drug markets were driven by a libertarian trade ethic favoring unregulated exchange in encrypted online spaces (Maddox et al. 2016, Munksgaard & Demant 2016). However, cultural analysis has taken a back seat to research focused on revenue generated, trade frequency, and market outcomes, creating a gap in understanding how cultural norms, beliefs, and values permeate illicit trade within online markets. Still, some research has successfully adopted a cultural perspective. For instance, Aldridge & Askew's (2017) research took a cultural perspective to understand buyer behavior in an online drug market, revealing that beyond the reputation system, norms of information sharing influenced buyers' purchasing decisions (similarly expounded by Duxbury 2018). Other research illustrates how norms related to conflict resolution are critical in establishing trust between market actors (Morselli et al. 2018).

To advance research on market culture, two key directions can be pursued. First, computational methods can be harnessed to analyze the content, character, and quality of textual interactions posted on online discussion forums by market participants to examine how norms, beliefs, and values germinate and influence trade within these markets. The rich availability of text data on online illegal markets makes this approach promising for understanding the cultural underpinnings of these environments.

Second, cross-national comparative analyses of online illegal markets can uncover cultural heterogeneity and its role in influencing purchasing behaviors, conflict resolution, and the valuation of illegal goods. The predominant focus of cryptomarket research has been on English-language markets in Western nations, overlooking additional cross-national cultural distinctions that may yield valuable insights into the dynamics of these markets (e.g., Fligstein & Dauter 2007, Fourcade & Healy 2007). By examining the cultural norms and values that contour cross-national market behavior, researchers can better grasp online illegal trade's complexities and implications for societal dynamics resulting in more efficacious policy and policing efforts (Aldridge & Askew 2017, Morselli et al. 2018).

Market Failure

Examining the phenomenon of market failure² holds considerable promise for sociology's examination of illegal cryptomarket development and evolution. Prevailing research on drug cryptomarkets predominantly focuses on successful cryptomarkets, leaving unanswered questions about factors leading to market collapse. In online illegal trade settings, risks of victimization, scams, and the lack of state oversight elevate the probability of market failure (Beckert & Wehlinger 2013, Gambetta 2009). Many online illegal markets are short-lived, with drug cryptomarkets lasting only 18 months on average, underscoring the need to identify factors that lead to market stability or failure (UN Off. Drugs Crime 2021).

² In economics, market failure refers to a situation in which the allocation of goods and services in a free market is not efficient, leading to suboptimal outcomes for society. In this article, we refer to market failure to indicate the decline in market activity to the point where the market collapses and trade ceases to occur.

Understanding market failure bears substantial implications for policing strategies, especially considering that conventional tactics have shown limited effectiveness in reducing online illegal trade. Relying on large-scale arrest operations is costly, complex, and often unsuccessful (Ladegaard 2019, Norbutas et al. 2020). Because most drug cryptomarkets collapse early, it is critical to identify the conditions that prevent markets from progressing beyond their early stages to a more stable trade equilibrium. Identifying the dynamics of market failure may reveal the vulnerabilities and challenges confronting these markets, enabling more effective and efficient policing strategies to prevent the establishment of stable, long-lasting illegal markets.

Market Innovation

Technological innovation remains a driving force in the evolution of cryptomarkets, as these illegal markets constantly respond to emerging internal and external threats. One aspect of this innovation is the use of decentralized marketplace models, where transactions and interactions occur directly between buyers and sellers without the intervention of a central authority. This system enhances market participants' privacy and security while also minimizing the risk of law enforcement disruptions (Nakamoto 2008). Additionally, privacy-centered cryptocurrencies like Monero and Zcash have gained popularity in cryptomarkets, enhancing transaction privacy and anonymity, thereby rendering transaction tracing and participant identification even more challenging (Möser & Böhme 2017).

Furthermore, some cryptomarkets have incorporated escrow services using blockchain-based smart contracts to ensure secure and reliable transactions. These smart contracts facilitate automated fund release upon the fulfillment of predefined conditions, thereby ensuring the compliance of both parties with their obligations (e.g., Haber & Stornetta 1997). Another security measure adopted in certain cryptomarkets is the use of multi-signature wallets, mandating multiple private keys for transaction authorization and reducing the risk of fraud and theft (Antonopoulos 2014).

Other cryptomarkets have augmented vendor and product verification mechanisms to further cultivate customer trust and stabilize market operations. This encompasses background checks on vendors and the authentication of listed products (Christin 2013). Additionally, platforms continuously refine their user interfaces to deliver a seamless and user-friendly experience, drawing in more users and increasing engagement (Böhme et al. 2015). Reputation systems remain critical for fostering trust among market participants and continue to evolve to counteract fraudulent activities and ensure reliable trade (Resnick & Zeckhauser 2002).

While these innovations reflect the dynamic nature of online illicit markets, further research is needed to fully understand their implications. Sociologists must analyze how these additional innovations change market behaviors, trust dynamics, and overall market functioning. Moreover, future research is needed to investigate the broader consequences of these innovations, such as their impact on criminal justice strategies, law enforcement practices, and public health.

Stratification

Investigating the impact of online illegal markets on social stratification is a crucial area of research where sociology's unique insights are particularly important. The potential benefits derived from engaging in illegal online trade, particularly in terms of reduced violence and safer substance use, are not equally accessible to all segments of society. Participating in illegal online markets requires access to Internet resources and a certain level of digital fluency to navigate encrypted online settings effectively. These prerequisites likely create barriers for disadvantaged individuals lacking technology access or proficient digital skills. In addition, as research indicates that illicit goods often command higher prices when purchased online compared with traditional offline markets, financial barriers will prevent less economically affluent consumers from reaping any potential benefits of online illegal

trade (Barratt et al. 2014, Moeller et al. 2021, UN Off. Drugs Crime 2021). This socioeconomic disparity creates a situation where more affluent groups can opt out of the potential hazards linked with purchasing illicit goods offline, such as contamination risk, violence, victimization, and arrest, by opting for the relative security and product assurance offered by online markets.³

Thus, expanding online markets can further exacerbate the marginalization of disadvantaged groups by increasing the probability of law enforcement detection and arrest. The extent to which unequal access to online illegal trade insulates privileged actors from the risks associated with offline illegal trade remains underexplored and is an area ripe for sociological exploration. Addressing these market-use disparities requires comprehensive policies acknowledging broader societal contexts, such as stratification systems in place. While online markets may bring some potential advantages for a select consumer group, they also pose substantial risks for online users, requiring a balanced policy that considers both public safety and individual freedoms. Policymakers must carefully weigh the consequences of online illegal trade while accounting for public health and societal implications.

Overall, further exploration of online illegal markets offers several promising avenues for sociologists to broaden scientific knowledge about these multifaceted systems. Examining market culture, norms, beliefs, and values shaping illegal trade sheds light on trust dynamics and conflict resolution among market actors. Developing a better understanding of market failures and success is crucial for effective policing strategies to forestall online illegal markets from reaching stable trade equilibria. Evolving cryptomarket trends, like decentralized marketplaces, privacy-centric cryptocurrencies, and reputation systems, present fresh challenges and opportunities for sociological inquiry. Additionally, exploring the repercussions of online illegal markets on social stratification, violence, and individual health outcomes can provide valuable insights into the broader societal implications of these markets. Through collaborative, evidence-based research, sociologists contribute to a more comprehensive and nuanced understanding of online illegal trade's intricate and ever-evolving landscape.

CONCLUSION

Online illegal markets have reshaped the landscape of illegal trade, disrupting traditional patterns and dynamics undergirding traditional drug markets (Aldridge & Décary-Héty 2016, Barratt 2012, Barratt & Aldridge 2017). These digital platforms grant unprecedented access to illegal goods and transform how illegal trade is conducted and understood (Ladegaard 2020). The intricate interplay of formal reputations, social networks, and trust mechanisms reveals a complex ecosystem that extends beyond conventional market analyses. By examining these markets through a sociological lens, we gain insights into the multifaceted interactions, behaviors, and implications that shape this modern phenomenon.

The digital nature of online illegal markets has fostered transparency in trade practices, enabled technical innovations, and encouraged open discussions of illegal behavior. Yet, the depth of these markets goes beyond superficial evaluations. Buyers and sellers are embedded within intricate trade networks that considerably influence market behaviors. Thus, the study of online illegal markets necessitates a holistic approach that considers the dynamics of these networks alongside analyzing the role of formal reputations and conducting cost-benefit analyses. Sociologists, equipped with a multifaceted toolkit spanning technology, markets, crime, health, and social behavior, are well-positioned to examine the complexities inherent in these illegal digital marketplaces. As online illegal markets continue to evolve, continuous research and analysis will be essential to keep pace with their dynamic nature and address the broader societal implications effectively.

³ In one sense, online illegal markets amplify patterns of stratification that occur in street-level drug markets where the least privileged actors are most likely to receive the harshest sanctions for illegal drug sales or possession.

In conclusion, this article offers a comprehensive exploration of the intricate dynamics within online illegal markets, particularly focusing on drug cryptomarkets. However, the insights derived from this analysis extend far beyond the realm of drug trade and hold relevance for understanding and addressing a wide range of other online illegal markets. For example, similar to drug cryptomarkets, online platforms play a significant role in the sex work industry. Sex workers and clients often rely on digital platforms to connect, negotiate services, and ensure safety. Trust and reputation among participants are crucial in this context as well. Just as in drug cryptomarkets, the exchange of information and reviews about sex workers' services on online forums and platforms fosters a sense of trust and allows clients to make informed decisions. Understanding these trust-building mechanisms and the role of online communication is essential for comprehending the dynamics of online sex work markets. In the realm of illegal credit card trading, for example, participants engage in underground markets to buy and sell stolen credit card information. Just as in drug cryptomarkets, networks and reputation systems are essential for facilitating trust and exchange. Buyers rely on signals about the trustworthiness of sellers and the quality of the stolen credit card data when determining trade partners. Understanding these dynamics can aid law enforcement agencies in targeting influential actors and disrupting these illicit markets effectively.

By applying the insights from this article to these examples and other online illegal markets, researchers and policymakers can gain a more nuanced understanding of the dynamics at play. This knowledge is crucial for developing effective strategies to address the complexities of these markets while considering their broader societal implications. As online illegal markets continue to evolve, a multidisciplinary approach, as exemplified in this article, will be instrumental in navigating the ever-changing landscape of illicit online trade.

DISCLOSURE STATEMENT

The authors are not aware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this review.

ACKNOWLEDGMENTS

This research was supported by two National Science Foundation grants: GRT0004637 and GRT1949037.

LITERATURE CITED

- Akerlof G. 1970. The market for 'lemons': quality uncertainty and the market mechanism. *Q. J. Econ.* 84(3):488–500
- Aldridge J, Askew R. 2017. Delivery dilemmas: how drug cryptomarket users identify and reduce their risk of detection by law enforcement. *Int. J. Drug Policy* 41:101–9
- Aldridge J, Décary-Héту D. 2016. Hidden wholesale: the drug diffusing capacity of online drug cryptomarkets. *Int. J. Drug Policy* 35:7–15
- Aldridge J, Stevens A, Barratt MJ. 2018. Will growth in cryptomarket drug buying increase the harms of illicit drugs? *Addiction* 113(5):789–96
- Antonopoulos A. 2014. *Mastering Bitcoin: Unlocking Digital Cryptocurrencies*. Sebastopol, CA: O'Reilly
- Axelrod R. 1984. *The Evolution of Cooperation*. New York: Basic
- Bakken SA, Moeller K, Sandberg A. 2018. Coordination problems in cryptomarkets: changes in cooperation, competition, and valuation. *Eur. J. Criminol.* 15(4):442–60
- Bancroft A, Reid P. 2016. Concepts of illicit drug quality among darknet market users: purity, embodied experience, craft, and chemical knowledge. *Int. J. Drug Policy* 35:42–49
- Barratt MJ. 2012. Silk Road: eBay for drugs. *Addiction* 107(3):683
- Barratt MJ, Aldridge J. 2017. Everything you always wanted to know about drug cryptomarkets* (*but were afraid to ask). *Int. J. Drug Policy* 35:1–6

- Barratt MJ, Ferris JA, Winstock AR. 2014. Use of Silk Road, the online drug marketplace, in the United Kingdom, Australia, and the United States. *Addiction* 109(5):774–83
- Barratt MJ, Ferris JA, Winstock AR. 2016a. Safer scoring? Cryptomarkets, social supply, and drug market violence. *Int. J. Drug Policy* 35:24–31
- Barratt MJ, Lenton A, Maddox A, Allen M. 2016b. ‘What if you live on top of a bakery and you like cakes?’—Drug use and harm trajectories before, during, and after the emergence of Silk Road. *Int. J. Drug Policy* 35:50–57
- Becker G, Murphy K, Grossman M. 2006. The market for illegal goods: the case of drugs. *J. Political Econ.* 114(1):38–60
- Beckert J. 2009. The social order of markets. *Theory Soc.* 38:245–69
- Beckert J, Wehlinger F. 2013. In the shadows: illegal markets and economic sociology. *Socio-Econ. Rev.* 11:5–30
- Böhme R, Christin N, Edelman B, Moore T. 2015. Bitcoin: economics, technology, and governance. *J. Econ. Perspect.* 29(2):213–38
- Bouchard M. 2007. On the resilience of drug markets. *Glob. Crime* 8(4):325–44
- Bouchard M, Wilkins C. 2009. *Illegal Markets and the Economics of Organized Crime*. London: Routledge
- Braga AA, Turchan B, Papachristos AV, Hureau DM. 2019. Hot spots policing of small geographic areas effects on crime. *Campbell Syst. Rev.* 15(3):e1046
- Bright D, Koskinen J, Malm A. 2018. Illicit network dynamics: the formation of a drug trafficking network. *J. Quant. Criminol.* 35(1):237–58
- Bushway S, Reuter P. 2008. Economists’ contribution to the study of crime and the criminal justice system. *Crime Justice* 37:389–451
- Case A, Deaton A. 2020. *Deaths of Despair and the Future of Capitalism*. Princeton, NJ: Princeton Univ. Press
- Caulkins JP, Reuter P. 2010. Illicit drug markets and economic irregularities. *Socio-Econ. Plan. Sci.* 40(1):1–14
- Christin N. 2013. Traveling the Silk Road: a measurement analysis of a large anonymous online marketplace. In *WWW ’13: Proceedings of the 22nd International Conference on the World Wide Web*, pp. 213–24. New York: Assoc. Comput. Mach.
- Cloward RA, Ohlin LE. 1960. *Delinquency and Opportunity: A Theory of Delinquent Gangs*. New York: Free Press
- Cox J. 2016. Reputation is everything: the role of ratings, feedback, and reviews in cryptomarkets. In *Internet and Drug Markets*, pp. 41–47. Luxembourg: Publ. Off. Eur. Union
- Cunningham RM, Walton M, Carter P. 2018. The major causes of death in children and adolescents in the United States. *J. New Engl. J. Med.* 379:2468–75
- Décary-Héty D, Dupont B. 2012. The social network of hackers. *Glob. Crime* 13(3):160–75
- Décary-Héty D, Giommoni L. 2017. Do police crackdowns disrupt drug cryptomarkets? A longitudinal analysis of the effects of Operation Onymous. *Crime Law Soc. Change* 67(1):55–75
- Décary-Héty D, Laferrière D. 2015. Discrediting vendors in online criminal markets. In *Disrupting Criminal Networks: Network Analysis in Crime Prevention*, ed. G Bichler, AE Malm, pp. 129–52. Boulder, CO: Lynne Rienner
- Diekmann A, Jann B, Przepiorka W, Wherli S. 2014. Reputation formation and the evolution of cooperation in anonymous online markets. *Am. Sociol. Rev.* 79(1):65–85
- Duxbury SW. 2018. Information creation on online drug forums: how drug use becomes moral on the margins of science. *Curr. Sociol.* 66(3):431–48
- Duxbury SW, Haynie DL. 2018a. Building them up, breaking them down: topology, vendor selection, and a digital drug markets’ robustness to disruption. *Soc. Netw.* 52:238–50
- Duxbury SW, Haynie DL. 2018b. The network structure of opioid distribution on a darknet cryptomarket. *J. Quant. Criminol.* 34(4):921–41
- Duxbury SW, Haynie DL. 2019. Criminal network security: an agent-based approach to evaluating network resilience. *Criminology* 57(2):314–42
- Duxbury SW, Haynie DL. 2020. The responsiveness of criminal networks to intentional attacks: disrupting darknet drug trade. *PLOS ONE* 15(9):e0238019
- Duxbury SW, Haynie DL. 2021. Shining a light on the shadows: endogenous trade structure and the growth of an online illegal market. *Am. J. Sociol.* 127(3):787–827

- Duxbury SW, Haynie DL. 2023a. Network embeddedness in illegal online markets: endogenous sources of prices and profit in anonymous criminal drug trade. *Socio-Econ. Rev.* 21(1):25–50
- Duxbury SW, Haynie DL. 2023b. The asymmetry of embeddedness: trade network structure and drug purchasing diversity in an online illegal market. *Soc. Forces* 2023:soad134
- Fligstein N. 2001. *The Architecture of Markets: An Economic Sociology of Twenty-First Century Societies*. Princeton, NJ: Princeton Univ. Press
- Fligstein N, Dauter L. 2007. The sociology of markets. *Annu. Rev. Sociol.* 33:105–28
- Fourcade M, Healy K. 2007. Moral views of market society. *Annu. Rev. Sociol.* 33:285–305
- Gambetta D. 2009. *Codes of the Underworld: How Criminals Communicate*. Princeton, NJ: Princeton Univ. Press
- Granovetter M. 1985. Economic action and social structure: the problem of embeddedness. *Am. J. Sociol.* 91:481–510
- Greif A. 2006. *Institutions and the Path to the Modern Economy: Lessons From Medieval Trade*. Cambridge, UK: Cambridge Univ. Press
- Haber S, Stornetta WS. 1997. Secure names for bit-strings. In *CCS '97: Proceedings of the 4th Conference on Computer and Communications Security*, pp. 28–36. New York: Assoc. Comput. Mach.
- Hedegaard H, Warner M, Minino A. 2017. *Drug overdose deaths in the United States, 1999–2016*. NCHS Data Brief, Natl. Cent. Health Stat., Hyattsville, MD
- Hillmann H, Aven BL. 2011. Fragmented networks and entrepreneurship in late imperial Russia. *Am. J. Sociol.* 117(2):484–538
- Hofstra B, Corten R, van Tubergen F, Ellison NB. 2017. Sources of segregation in social networks: a novel approach using Facebook. *Am. Sociol. Rev.* 82(3):625–56
- Kilmer B, Everingham S, Caulkins JP, Midgette G, Pacula RL, et al. 2014. *What America's users spend on illegal drugs, 2000–2010*. Rep., RAND Corp., Santa Monica, CA
- Kollock P. 1994. The emergence of exchange structures: an experimental study of uncertainty, commitment, and trust. *Am. J. Sociol.* 100(2):313–45
- Kollock P. 1999. The production of trust in online markets. *Adv. Group Process.* 16:99–123
- Ladegaard I. 2019. Crime displacement in digital drug markets. *Int. J. Drug Policy* 63:113–21
- Ladegaard I. 2020. Open secrecy: how police crackdowns and creative problem-solving brought illegal markets out of the shadows. *Soc. Forces* 99(2):532–59
- Lewis K, Kaufman J, Gonzalez M, Wimmer A, Christakis N. 2008. Taste, ties, and time: a new social network dataset using Facebook.com. *Soc. Netw.* 30(2008):330–42
- Maddox A, Barratt MJ, Allen M, Lenton S. 2016. Constructive activism in the dark web: cryptomarkets for illicit drugs in the digital 'demimonde.' *Inf. Commun. Soc.* 19:111–26
- Martin J. 2014. Lost on the *Silk Road*: online drug distribution and the 'cryptomarket'. *Criminol. Crim. Justice* 14(3):351–67
- Martin J, Cunliffe J, Décary-Héty D, Aldridge J. 2018. Effect of restricting the legal supply of prescription opioids on buying through online illicit marketplaces: interrupted time series analysis. *Br. Med. J.* 361:k2270
- Martin J, Munksgaard R, Demant Coomber J, Barratt MJ. 2020. Selling drugs on darkweb cryptomarkets: differentiated pathways, risks, and rewards. *Br. J. Criminol.* 6(4):811–29
- Masson K, Bancroft A. 2018. 'Nice people doing shady things': drugs and the morality of exchange in the darknet cryptomarkets. *Int. J. Drug Policy* 58:78–84
- McGloin JM. 2005. Policy and intervention considerations of a network analysis of street gangs. *Criminol. Public Policy* 4(3):607–35
- Merton R. 1937. Social structure and anomie. *Am. Sociol. Rev.* 3:672–82
- Moeller K, Munksgaard R, Demant J. 2021. Illicit drug prices and quantity discounts: a comparison between a cryptomarket, social media, and police data. *Int. J. Drug Policy* 91:102969
- Moeller K, Sandberg S. 2019. Putting a price on drugs: an economic sociological study of price formation in illegal drug markets. *Criminology* 56(2):289–313
- Morselli C, Décary-Héty D, Paquet-Clouston M, Aldridge J. 2018. Conflict management in illicit drug cryptomarkets. *Int. Crim. Justice Rev.* 27(4):237–54

- Möser M, Böhme R. 2017. The price of anonymity: empirical evidence from a market for Bitcoin anonymization. *J. Cybersecur.* 3(2):127–35
- Munksgaard R, Demant J. 2016. Mixing politics and crime—the prevalence and decline of political discourse on the cryptomarket. *Int. J. Drug Policy* 35:77–83
- Munksgaard R, Tzanetakis M. 2022. Uncertainty and risk: a framework for understanding pricing in online drug markets. *Int. J. Drug Policy* 101:103535
- Nakamoto S. 2008. Bitcoin: a peer-to-peer electronic cash system. *Decentralized Bus. Rev.* <https://assets.pubpub.org/d8wct41f/31611263538139.pdf>
- Norbutas L, Ruiter S, Corten R. 2020. Reputation transferability across contexts: maintaining cooperation among anonymous cryptomarket actors when moving between markets. *Int. J. Drug Policy* 76:102635
- Norbutas L, Ruiter S, Corten R. 2021. Believe it when you see it: dyadic embeddedness and reputation effects on trust in cryptomarkets for illegal drugs. *Soc. Netw.* 63:150–61
- Ouellet M, Decary-Hetu D, Bergeron A. 2021. Cryptomarkets and the returns to criminal experience. *Glob. Crime* 23:65–80
- Papachristos AV, Hureau D, Braga A. 2013. The corner and the crew: the influence of geography and social networks on gang violence. *Am. Sociol. Rev.* 78(3):417–47
- Perrin A. 2014. *American Democracy: From Tocqueville to Town Halls to Twitter*. New York: Wiley
- Podolny J. 2001. Networks as the pipes and prisms of the market. *Am. J. Sociol.* 107(1):33–60
- Podolny J. 2010. *Status Signals: A Sociological Study of Market Competition*. Princeton, NJ: Princeton Univ. Press
- Przepiorka W, Norbutas L, Corten R. 2017. Order without law: reputation promotes cooperation in a cryptomarkets for illegal drugs. *Eur. Sociol. Rev.* 33(6):752–64
- Resnick P, Zeckhauser R. 2002. Trust among strangers in Internet transactions: empirical analysis of eBay's reputation system. In *The Economics of the Internet and E-Commerce*, ed. MR Baye, pp. 127–57. Bingley, UK: Emerald
- Shaw C, McKay HD. 1942. *Juvenile Delinquency and Urban Areas*. Chicago: Univ. Chicago Press
- Smith CM, Papachristos AV. 2016. Trust thy crooked neighbor: multiplexity in Chicago organized crime networks. *Am. Sociol. Rev.* 81(4):644–67
- Tzanetakis M, Kamphausen G, Werse B, von Laufenberg R. 2016. The transparency paradox: building trust, resolving disputes, and optimizing logistics on conventional and online drug markets. *Int. J. Drug Policy* 35:58–68
- UN Off. Drugs Crime. 2021. *World Drug Report 2021*. Rep., UN Off. Drugs Crime, Vienna, Austria
- Uzzi B. 1996. The sources and consequences of embeddedness for the economic performance of organizations: the network effect. *Am. Sociol. Rev.* 61(4):674–98
- Uzzi B. 1997. Social structure and competition in interfirm networks: the paradox of embeddedness. *Adm. Sci. Q.* 42:35–67
- Uzzi B, Lancaster R. 2004. Embeddedness and price formation in the corporate law market. *Am. Sociol. Rev.* 69(3):319–44
- Van Hout M, Bingham T. 2014. Responsible vendors, intelligent consumers: Silk Road, the online revolution in drug trading. *Int. J. Drug Policy* 24(6):524–29
- Venkatesh SA. 1997. The social organization of street gang activity in an urban ghetto. *Am. J. Sociol.* 103(1):82–111
- Walsh C. 2011. Drugs, the Internet and change. *J. Psychoactive Drugs* 43(1):55–63
- Weisburd D, Braga AA, Groff ER, Wooditch A. 2017. Can hot spots policing reduce crime in urban areas? An agent-based simulation. *Criminology* 55(1):137–73
- Winstock AR, Maier LJ, Zhuparris A, Davies E, Puljevic C, et al. 2021. *Global Drug Survey (GDS) 2021 key findings report*. Rep., Glob. Drug Surv., London