Online drug trade networks might still be heavily shaped by offline (geographic) constraints, despite their ability to provide access for end-users to large international supply. Cryptomarkets might be more "localized” and less international than thought before. We discuss potential explanations for such geographical clustering and implications of the findings.

Methods: We use publicly available crawls of the cryptomarket Abraxas, encompassing market transactions between 463 sellers and 3542 buyers of drugs in 2015. We use descriptive social network analysis and Exponential Random Graph Models (ERGM) to analyze the structure of the trade network.

Results: The structure of the online drug trade network is primarily shaped by geographical boundaries. Buyers are more likely to buy from multiple sellers within a single country, and avoid buying from sellers in different countries, which leads to strong geographic clustering. The effect is especially strong between continents and weaker for countries within Europe. A small fraction of buyers (10%) account for more than a half of all drug purchases, while most buyers only buy once.

Conclusion: Online drug trade networks might still be heavily shaped by offline (geographic) constraints, despite their ability to provide access for end-users to large international supply. Cryptomarkets might be more “localized” and less international than thought before. We discuss potential explanations for such geographical clustering and implications of the findings.
trade using sellers’ self-reported origin country and shipping destination data (Broséus et al., 2017; Cunliffe, Martin, Décary-Hétu, & Aldridge, 2017; Décary-Hétu et al., 2016). Based on information from Silk Road, Décary-Hétu et al. (2016) found that 69% of analyzed listings, mostly illicit drugs, were open for international orders. Sellers who offered international shipping held 61% of total market revenues. Although it is unclear what share of these revenues came from internationally shipped items, the findings suggest that a significant share of drug sellers were willing to ship internationally. Broséus et al. (2017) and Cunliffe et al. (2017) found that trade of illegal drugs is primarily domestic in Australia, while a larger proportion of sellers from the United States, Canada, Netherlands, Germany and China offered international shipping.

Analyses of international flows of drugs that are based on geographical information provided by cryptomarket sellers suffer from several significant sources of bias. First, many sellers do not disclose their origin country for security reasons. In previous research such cases were either excluded from the analyses or, due to missing information on origin countries, could not provide information about whether these sellers trade internationally. For example, Décary-Hétu et al. (2016) excluded 8% of their collected sample of item listings due to ambiguous sellers’ origin locations. Broséus et al. (2017) found that about 37% of sellers of illicit drugs in Evolution market listed “Worldwide” as their country of origin. Van Buskirk et al. (2016) found that 21% of analyzed drug listings were shipped from undeclared locations in Agora. This issue could have an impact on the reliability of previous results, especially if sellers’ willingness to disclose their origin country is associated with willingness to ship internationally.

Secondly, previous research on geographical patterns in cryptomarkets did not incorporate information on the buyers. Information on sellers’ origin countries and shipping destinations cannot reveal what fraction of items that have an option for international shipping are bought by foreign-based and not domestic buyers. This could lead to an underestimation of domestic drug trade in cryptomarkets.

We address these issues by analyzing a complete cryptomarket drug trade network, using a social network analysis approach. We construct a network of exchanges between buyers and sellers of illicit drugs and analyze network clustering patterns that might emerge due to geographic constraints. Analysis of a cryptomarket exchange network has several advantages. We can incorporate data on sellers and their items with missing or ambiguous origin countries (e.g. ‘Worldwide’), since buyers’ and sellers’ positions in the global network structure can be a strong signal of their geographic location. Emergent structural patterns of a global buyer-seller exchange network can also be considered a more reliable representation of drug trafficking flows than sellers’ willingness to ship internationally, since they are based on completed exchanges rather than sellers’ intentions.

Social network analysis has been used to study the structure of offline drug trafficking networks (Kenney, 2007; Morselli, 2009; Malm & Bichler, 2011; Natarajan, 2006; Wood, 2017), online discussion forums of hackers (Holt, Strumsky, Smirnova, & Kilger, 2012; Lu, Luo, Polgar, & Cao, 2010) and stolen data markets (Monsma, Bukens, Soudijn, & Nieuwbeerta, 2013; Motoyama et al., 2011). This approach has also been used to study trust considerations between opioid buyers and sellers in a cryptomarket (Duxbury & Haynie, 2017, 2018). The results show that the opioids’ exchange network is highly clustered, but not geographically – buyers tend to exchange with few well-reputed sellers. The lack of any geographic structure in this network is counter-intuitive, given that a significant share of sellers in many cryptomarkets only ship domestically (Décary-Hétu et al., 2016; Broséus et al., 2017). This finding could be heavily influenced by the relatively small subset of the total cryptomarket network analyzed, especially given that the absolute majority of analyzed sellers were from a single country.

Here we use a complete buyer-seller trade network data set from a cryptomarket Abraxas (Branwen et al., 2015). To our knowledge, apart from the anonymous cryptomarket analyzed by Duxbury and Haynie (2017), this is the only marketplace where buyer identifiers are available for each transaction. We construct a full buyer-seller trade network with information on almost 11,000 trades of drugs between 463 sellers and 3542 buyers, over a period of 7 months in 2014–2015. These unique data allow us to explore the structure of online drug trade in detail and shed light on possible mechanisms that underlie formation of such networks.

Structure of offline and online retail drug trade networks

To operate efficiently, markets must minimize the amount of uncertainty for its actors, to make assessment of costs and benefits of a potential exchange possible (Beckert & Wehinger, 2012). Contracts in illegal markets are not secured by law, which increases potential risks for market actors and makes them turn to alternative strategies to minimize uncertainty and potential losses (Reuter, 1983).

The level of uncertainty and the resulting behavior of buyers and sellers might differ depending on whether illegal market exchanges take place online or offline (Brynjolfsson & Smith, 2000; Gambini et al., 2011). Buyers and sellers in offline retail drug trade networks face uncertainty with regards to true intentions of their exchange partners. Face-to-face contacts lead to increased risk of violence and potential exposure to law enforcement for both, buyers and sellers (Bouchard & Ouellet, 2011; Jacques & Wright, 2011). Additionally, buyers face uncertainty with regards to quality and purity of purchased drugs, since drug markets are “markets for lemons”, characterized by substantial information asymmetry between buyers and sellers with regards to true quality of the goods (Akerlof, 1970; Reuter & Caulkins, 2004). Information about trustworthiness of sellers and quality of their goods is scarce, which makes it costly for buyers to look for market alternatives (Galenianos, Pacula, & Persico, 2012).

The risk of violence and exposure to law enforcement, product quality uncertainty and a lack of information about trustworthiness often lead actors in offline retail drug markets to form “closed”, “overembedded” or highly clustered trade networks, where they form small, fragmented groups, consisting of long-lasting dyads of repeated interactions (May & Hough, 2004; Uzzi, 1997). Drug sellers have been found to screen potential customers for trustworthiness and incentivize long-term clients by offering credit or discounts (Chalmers & Bradford, 2013; Jacques, Allen, & Wright, 2014). The geographic area of retail drug sellers’ activity might be limited deliberately to prevent additional exposure to law enforcement (Reuter, 1983). Since illegal drugs are consumer goods, buyers, learning from their successful transactions with a seller in the past and facing high search costs for alternatives, have an incentive to maintain existing cooperation (Buskens & Raub, 2002).

Online drug markets, just like online markets for legal goods, might reduce many of these uncertainties and lead to more dynamic, open and efficient retail drug trade networks (Brynjolfsson & Smith, 2000; Gambini et al., 2011). Cryptomarkets increase information availability for buyers – complete lists of items and sellers on the market can reduce search costs and make it easier to choose the best market alternative (Gambini et al., 2011). Buyers and sellers gain ease access to international markets, where drugs are sold, which are not available locally (Van Buskirk, Naicker, Roxburgh, Bruno, & Burns, 2016). Due to absence of face-to-face contact and increased anonymity, sellers can be more expansive – exposure to more buyers no longer increases risk of being arrested (Morselli, Gigüere, & Peti, 2007; Reuter, 1983). Finally, cryptomarket buyers can assess sellers’ trustworthiness and product quality via reputation systems, which publicly disseminate buyers’ feedback based on their past transactions with each seller (Hardy & Norgaard, 2016; Przepiorka et al., 2017).

An important source of risk in online drug markets that might diminish their ability to transform localized and dyadically embedded offline drug trade networks, is the shipping stage of online exchanges (Aldridge & Askew, 2017). International shipping of packages leads to
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