Research Paper

Assessing market competition and vendors' size and scope on AlphaBay

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\section*{A B S T R A C T}

\textbf{Background:} Since 2011, drug market participants have traded illegal drugs through cryptomarkets, a user-friendly infrastructure in which drug market participants can conduct business transactions. This study assesses market competition and the size and scope of drug vendors’ activities on one of the largest cryptomarkets, AlphaBay, in order to better understand the challenges that drug vendors face when selling on this venue.

\textbf{Methods:} Relying on data collected from AlphaBay, we calculate the degree of competition within the drug market using the Herfindahl-Hirshman Index (HHI). We then follow a micro analytical approach and assess the size and scope of vendors’ accounts. This is done by evaluating each vendor’s market share over time using a group-based trajectory model (GBTM). Results from the GBTM are then used to assess vendors’ exposure, diversity and experience based on their selling position in the market.

\textbf{Results:} The HHI scores demonstrate that cryptomarkets offer a highly competitive environment that fits in a top-heavy-market structure. However, the distribution of vendors’ market share trajectories shows that only a small portion of vendors (referred to as high-level vendors) succeed in generating regular sales, whereas the majority of vendors are relegated to being mere market spectators with almost zero sales. This inequality is exacerbated by the aggressive advertising of high-level vendors who post many listings. Overall, product diversity and experience is limited for all market participants regardless of their level of success. We interpret these results through Reuter’s work on traditional illegal markets, e-commerce studies and the growing field of cryptomarket research.

\textbf{Conclusion:} We conclude that, while offering a new venue for illegal drug transactions, in many ways, the economics of cryptomarkets for drug dealing are consistent with Reuter’s classic assessment of illegal markets and the consequences of product illegality that underlie it. Cryptomarkets conflicting features, a relatively open setting with relatively high barriers to entry and sales, shape the competitive, yet top-heavy market that emerges from our analysis. This creates a challenging environment for cryptomarket drug dealers.

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\section*{Introduction}

Illegal drug markets are dynamic settings where market participants adapt to continually changing constraints and opportunities. This adaptation routinely leads to the displacement of illegal activities and "the relocation of a crime from one place, time, target, offense, tactic, or offender to another" (Guertet & Bowers, 2009: 1333). Tactical displacement is arguably one of the most common forms of displacement and has been analyzed in the past by looking at how offenders adopt new technologies. This study follows the adoption by drug dealers and drug buyers of multiple online anonymizing technologies that have led to the creation of cryptomarkets (Martin 2014a,b), also known as darknet markets (Rhumorbarbe, Staehli, Broséus, Rossy, & Esseiva, 2016) or anonymous online marketplaces (AOMs; see Christin, 2013). Cryptomarkets have all the visual attributes of popular online merchant websites like eBay and Amazon insofar as they present homepages with a grid of listings to buyers who can browse through thousands of ads for illicit drugs (Barratt, 2012). All purchases are then hidden in packages shipped through legal postal services. Cryptomarkets represent a new anonymous and international arena for illegal drugs sales and their impact on the illicit drug business has been the subject of considerable debate.

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(Barratt, Ferris, & Winstock, 2013; Martin, 2014a). To better understand the extent to which cryptomarkets shape the drug business, this study assesses market competition and the size and scope of drug vendors’ activities on one of the largest cryptomarkets.

In the following sections, we first consider the impact of product illegality on drug markets and how technology influences commerce and sales. We then introduce online illicit markets and the subsequent rise of cryptomarkets in the 2010s. Using data collected on one of the largest cryptomarkets for illegal drugs, we continue by evaluating the degree of competition on the drug market. Then, we assess the size and scope of cryptomarket drug vendors through time, as well as their experience, exposure, and diversity according to their position in the market. These results are used to evaluate the structural challenges that drug vendors must face on cryptomarkets, which are examined in details in the discussion section.

**Drug markets**

Reuter (1983) found that the illegality of a market commodity affects the way firms undertake production and distribution. Illegality creates constraints that impose high cost-transaction conditions which result in illegal firms remaining small, fragmented, ephemeral and undiversified in their activities and prevent them from gaining an edge in the market. Reuter argued that most costs associated with the supply of illegal goods and services originate from the number of individuals involved and the coordination of group activities. Firms that supply illegal goods and services operate in a risky extra-legal environment in which arrests and asset seizures are a constant risk. To minimize such risks, illegal firms must control the flow of information about their activities, which prevents them from launching advertising campaigns (Kleiman, 1991; Reuter, 1983), thus forcing them to restrict their size and scope.

Much research on illegal drug markets is consistent with Reuter’s assessment of the size and scope of illegal firms and the consequences of product illegality. In contrast with the image of large-scale criminal organizations that dominate illegal markets, firms involved in selling illegal drugs have been found to be relatively small, consisting of fewer than 10 participants (Bouchard & Morselli, 2014). In interviews, drug entrepreneurs asserted that smaller groups of individuals are considered more secure than larger groups (Adler, 1993; Jacobs, 1999; Reuter & Haaga, 1989). Drug markets have also been found to be populated by small and flexible networks of free independent entrepreneurs always on the lookout for financial opportunities. Opportunistic entrepreneurs often come together for a limited set of transactions, with the aim of maximizing financial gains, disbanding shortly afterwards (Adler, 1993; Desroches, 2007; Morselli, 2009; Pearson, Hobbs, Jones, Tierney, & Ward, 2001). Arms-length associations between drug entrepreneurs are therefore generally short-lived compared with more enduring ideologically-driven criminal groups (Morselli, Giguère, & Petit, 2007).

While such constraints limit the typical illegal firm’s growth, little acumen and investment are required to enter, quit and re-enter drug markets (Adler, 1993; Bouchard, 2007), even at the higher echelons of the drug distribution chain (Reuter & Haaga, 1989). These studies combined suggest that illegal firms participating in drug markets are confronted with a very competitive environment that constrains how they operate. However, the economic environment is constantly changing, especially with the recent use of pseudonymous communication and payment technologies on the rise, providing drug dealers with a new distribution channel: online markets.

**Online markets**

A substantial amount of research has been devoted to studying the impact of the Internet on licit markets. Some studies have argued that online markets should generate more competitive pressure on online vendors (Ellison & Ellison, 2009; Brynjolfsson, Smith, & Yu Hu, 2003; Brynjolfsson & Smith, 2000). Search costs for buyers (the costs of searching for products and comparing their prices) are lower online because of fast and effective search engines (Brynjolfsson & Smith, 2000; Brynjolfsson et al., 2003). Switch costs for online buyers (costs associated with changing supplier for a specific product or service) are also lower because they can easily find and switch to other vendors when they are dissatisfied with their purchase (Cambini, Mecheri, & Virginia, 2011). Menu costs for vendors (the costs related to a change in how a product is priced) are expected to be insignificant for online markets, allowing retailers to optimally adjust prices to align with market demand with more flexibility (Brynjolfsson & Smith, 2000).

Despite these features, (Cambini et al., 2011) point out that online markets have yet to reach the high level of competition once predicted by economists. Rather, empirical research has shown that market power in online markets is highly concentrated (Brynjolfsson & Smith, 2000; Clay, Krishnan, & Wolff, 2001; Elberse, 2008; Wang & Zhang, 2015). This is a result of consumers’ willingness to pay higher prices for goods sold by reputable online vendors compared with goods sold by unrated vendors (Smith & Brynjolfsson, 2001). Branding has also proven to be of great importance for online buyers because they are concerned with unobservable quality control (Latcovich & Smith, 2001). Advertising is perceived as a signal of reliability and security in online shopping. This can increase the market power of vendors who make significant investments in advertising aimed at building a good reputation in online markets while also pushing out smaller competitors with lower advertising budgets. Wang and Zhang (2015) reported that because online markets are large virtual settings where vendors face high fixed costs and low marginal costs, they are motivated to aggressively advertise their products and services.

The literature on e-commerce informs us on the different economic forces that influence the structure of online licit markets. Keeping this in mind, we now look at online illegal markets where illegal goods and services are sold.

**Cryptomarkets**

Studies investigating the impact of the Internet on markets’ structural features are becoming increasingly relevant for criminologists as illegal firms shift their activities online. Past research (Yip, Webber, & Shadboldt, 2013; Wehinger, 2011; Motoyama et al., 2011) has shown that online illicit markets have been active for more than 25 years, including discussion forums and chat rooms dealing in stolen financial information, hacking kits, fake identity papers, stolen account credentials, spam and hacking services. These markets provide convergence settings where participants, either acting alone or in firms, put up listings and transact with one another anonymously. The anonymity of these markets has generated uncertainty among participants because scammers regularly exploit participants with impunity. Thus, to circumvent the risks associated with transaction failures, market
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