

# Hydra: Lessons from the World's Largest Darknet Market

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## Abstract

### Research Summary

We present a comprehensive description of Hydra, the largest darknet marketplace in the world until its shutdown in April 2022. This paper documents the main features of this online platform (such as user feedback, escrow, dispute resolution, and certification of drug quality) and quantitatively examines the scale and the structure of the marketplace. Using data scraped from the platform, we find that the marketplace appears to have been highly competitive, geographically covering 69% of the Russian population, and trading a wide variety of drugs. Hydra was also used for deals between producers and sellers, who traded wholesale quantities of drugs and precursors. The dead-drop delivery system utilized on Hydra was expensive, as the courier costs comprised a substantial proportion of the sale price of drugs on Hydra. Finally, by examining product feedback we find that despite evidence that reputation was of critical importance to the operation of the platform, user ratings were skewed towards the highest possible rating value.

### Policy Implications

Hydra provides a unique counterfactual of a dominant marketplace that was allowed to grow for a long time before being shut down. By analyzing the case of Hydra, this study illustrates novel implications of the shut-down policies which governments typically use in response to illegal darknet marketplaces. The major cost of allowing a large marketplace to exist is an overall increase in the consumption of illegal drugs. However, this cost must be weighed against the potential benefits, including a higher quality of drugs due to reputation incentives, a decrease in potential violence due to the digitalization of the supply side, and the incentives for a large marketplace to self-regulate.

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# 1 Introduction

Prior to its shutdown in April 2022<sup>1</sup>, the majority of the retail drug trade in Russia was conducted through Hydra, the largest darknet marketplace in the world at the time. Unlike their Western counterparts, Russian drug enforcement appears not to have focused on directly attacking darknet marketplaces, instead primarily focusing on low-level market participants, e.g., couriers. As a result, Hydra existed for a substantially longer period than any other popular darknet marketplace, thus allowing it to grow significantly larger than any market operated in the US or Western Europe. During its years of operation, the marketplace developed an ecosystem that allowed for anonymous communication between multiple segments of the drug market, from wholesalers to end consumers. While it only served the Russian-speaking world, the success of this marketplace provides useful insights into the future of the retail drug trade and the potential implications of allowing a darknet marketplace to grow and develop over several years.

Our paper describes Hydra in two ways. First, we provide a comprehensive account of the organization of the Hydra marketplace and the core services and mechanisms that contributed to its success. Operating on The Onion Router (Tor) network, Hydra facilitated the anonymity of all parties by using cryptocurrency for payments and dead-drops<sup>2</sup> for deliveries. At the same time, Hydra was a marketplace with active self-regulation, a system of advertisement for individual sellers/shops, and a feedback system of reviews and ratings for individual items and sellers. It also employed dispute resolution and special statuses, such as “trusted sellers”. Finally, Hydra attempted to provide its own version of conventional harm reduction strategies. It selectively tested some of the drugs offered on the platform to ensure quality and provided telemedicine consultations for customers.<sup>3</sup>

Second, using listings and review data scraped from Hydra, we examine relative demand across drug types on the platform, the spatial and price variation of listings, and the composition and concentration of the drug market on the platform.<sup>4</sup> We observe over 417,000 unique dead-dropped drug packages throughout Russia in April 2022 and find that mephedrone (31%), cannabis (18%), amphetamine (13%), and alpha-PVP (12%) were the most popular drugs on the marketplace. Hydra operated in 1,129 different settlements (cities, towns, and countryside) in every region of Russia, providing potential instantaneous access<sup>5</sup> to illegal drugs for 69% of the Russian population. Larger cities had a higher concentration of sellers and drug listings. More expensive drugs were distributed predominantly in wealthier areas, in particular around business districts. We also analyze the market concentration using the Herfindahl-Hirschman Index and find that the online market of illegal drugs was extremely competitive, both in general as well as at the level of individual drug types and regions. We estimate a model to disentangle the delivery cost from the sale price of drugs sold on Hydra. We find that the dead-drop system is a costly type of delivery; for some drugs, the courier cost accounts for more than 50% of the price of

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<sup>1</sup>On the 5<sup>th</sup> of April 2022, German federal police announced that in a joint operation with US enforcement agencies they had seized Hydra’s Germany-based servers and shut down the site (CNBC, 2022). In relation to this operation, the US Department of Justice has obtained an indictment against Dmitry Olegovich Pavlov for his alleged role in operating the company that administered Hydra’s servers (United States of America V. Dmitry Olegovich Pavlov, 2022). The terms of the indictment are conspiracy to distribute narcotics and conspiracy to commit money laundering. As of the time of writing, the marketplace remains inoperable although the moderators on Hydra have posted on other darknet forums claiming that Hydra will be brought back online. However, it is unclear whether Hydra will be open again, and there is growing anecdotal evidence that many shops that previously operated on Hydra have created their own marketplaces.

<sup>2</sup>Pre-hidden drug stashes that made the transactions possible without any physical interaction between sellers and buyers.

<sup>3</sup>The quality of these consultations, as well as the qualification of the people who were providing them, remains unclear.

<sup>4</sup>To the best of our knowledge, this paper is the first comprehensive quantitative assessment of this marketplace in academic literature. Zvonka (2017) is an early analysis of data scraped from Hydra and RAMP, the marketplace that Hydra initially competed against until RAMP was closed in 2017. The Project (2019) is a journalist-led investigation conducted in 2019 which was one of the first discussions of Hydra in the media.

<sup>5</sup>Some sellers on Hydra also used mail for selling drugs, though dead-drops were by far the most widespread delivery method.

the median dead-drop. Finally, we turn to reviews, which anecdotally were important for customers on Hydra. We find evidence that it was the text of reviews that is likely to matter, while ratings left by users are usually less informative and skewed towards the highest possible value of 10.

Taken together, our findings provide a detailed overview of what was the largest illegal drug marketplace in the world so far. The findings obtained from analyzing Hydra contribute to the emerging body of knowledge about illegal drug darknet markets. While the majority of such marketplaces are quickly shut down once they become popular (Bhaskar et al., 2019; Zambiasi, 2022), Hydra shows what may happen if a marketplace is left to grow without significant interference from law enforcement, developing a sophisticated platform that dominated traditional street trade in many major cities, while also implementing safeguards to protect sellers and customers.

We then turn to analyzing the implications of our findings for public policy. Hydra had been a dominant darknet marketplace in Russia for more than 5 years and developed into a sophisticated platform with rich functionality and many rules and mechanisms. The case of Hydra allows to understand better the consequences of the shutdown policies that governments typically utilize, as a crucial effect of these policies is that no large marketplace similar to Hydra emerges. We use our analysis of Hydra to highlight several key components of the policy trade-off behind shutdowns. On the one hand, an established marketplace has incentives to self-regulate, and presents an environment in which sellers have incentives to sustain a good reputation. This might increase the quality of drugs and the welfare of customers. In addition, compared to in-person trade, online marketplaces are associated with reduced violence. On the other hand, a large online drug marketplace is likely to increase both the demand for and supply of drugs due to convenience and decreased risks for customers, as well as the facilitation of communication and trade between market agents on the supply side. Drawing from our analysis of Hydra, we argue that the policy trade-off of shutting down similar marketplaces requires a balanced understanding of the positive and negative sides of letting such a marketplace exist.

## 2 Background

### 2.1 Dark web markets

Anonymous online markets are a rapidly growing industry. Originating with the development of the Silk Road in 2011, it is estimated that there were 118 online anonymous marketplaces in 2019 (United Nations Office on Drugs and Crime, 2021). Similar to clearnet marketplaces such as eBay and Amazon these platforms provide an interface for buyers and sellers to transact online. However, unlike clearnet markets, these platforms focus on trying to ensure the anonymity of parties through decentralized networks (such as Tor) and payment methods (e.g., Bitcoin<sup>6</sup>), and the use of pseudonyms. Given the relative anonymity of these platforms, they are able to specialize in “black market” goods such as drugs and weapons. The UNOCD estimates that up to 90% of darknet sales were in fact drug related (United Nations Office on Drugs and Crime, 2021, p.76).

Drug markets have received significant attention from social scientists, particularly economists and criminologists (Caulkins and Reuter, 1998; Reuter and Greenfield, 2002; Martin et al., 2019). Traditional street markets for illegal goods, particularly narcotics, are difficult to observe. Hence, academic studies are generally required to rely either on data collected through law enforcement operations or surveys of market participants. The transition of illegal goods markets to the darknet has provided researchers with new sources of high-quality data which are more granular and of a higher frequency than previous sources.

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<sup>6</sup>Foley et al. (2019) estimate that illegal activities accounted for approximately 46% of all Bitcoin transactions in 2017, with 26% of Bitcoin users involved in them.

With the growing importance of online darknet marketplaces, the academic literature relating to these platforms has developed rapidly. Soska and Christin (2015) provides a descriptive analysis of the evolution of these marketplaces in the West, scraping listings from 16 marketplaces over two years to estimate the growth of these markets as well as the impact of platform exit, either through law enforcement intervention or exit-scams. The reputation systems of online drug markets have received particular focus by economists (Espinosa, 2019; Hardy and Norgaard, 2016, Aldridge et al., 2018; Bhaskar et al., 2019). These reputation systems address the moral hazard problems which one would expect to otherwise doom an illegal anonymous marketplace (Bhaskar et al., 2019; Hardy and Norgaard, 2016). In the absence of legal recourse for the delivery of adulterated products, which can have particularly harmful consequences, reputation mechanisms can serve not only to allow consumers to identify higher quality sellers but also increase the equilibrium quality in the market by raising the potential returns to being a high-quality seller.

Another potential societal benefit of these marketplaces is the substantially lower risk of violence relative to traditional street trade due to the reduction in face-to-face interactions between market participants (Aldridge et al., 2018). To the extent that these darknet marketplaces are also used for wholesale transactions, these benefits of reduced violence should also extend up the supply chain to reduce the violence and territorialism seen in the wholesale/broker market (Aldridge and Décary-Héту, 2014). In addition, these markets often provide forums where users can discuss harm reduction strategies in relation to the choice of drugs and best practices for consumption (Bancroft, 2017, Davitadze et al., 2020).

However, these platforms may also serve to make drugs more accessible, thus increasing overall drug consumption. Hence policymakers face a trade-off in deciding to intervene and shut down these markets. In the West, the policy has clearly focused on attempting to shut down these darknet marketplaces, with most markets having a lifespan of less than a year (Zambiasi, 2022). These shutdowns may serve to deter users as they cause parties to lose any funds deposited on the market as well as risk the release of personal data of users who have not correctly anonymized their data. However, there is little evidence of long-term deterrent effects (Décary-Héту and Giommoni, 2017; Miller, 2020). A major reason for this is that the online drug market appears to rebound quickly following individual market shutdowns with new markets replacing those which are taken down (Bhaskar et al., 2019; Soska and Christin, 2015). However, this discussion neglects an important effect of shutdowns: they prevent an emergence of a large marketplace dominating the market. This paper provides details of the counterfactual experience of what may occur if a darknet marketplace is given scope to develop. This counterfactual should provide policymakers with greater insight into the potential implications of changing the current policy of indiscriminately shutting down these markets whenever they become popular.

## **2.2 Hydra: the largest darknet marketplace**

While the Russian government has progressively tightened regulation on publishing information related to illicit drug use on the clearnet (Zheluk et al., 2014), darknet markets have entered Russia regardless. Over the last decade, several darknet markets have operated in Russia, such as RAMP and LegalRC. However, as of early 2022, Hydra was used much more widely than others. This marketplace was by far the largest darknet marketplace to have existed so far, with the US government estimating that 80% of all darknet market cryptocurrency transactions in 2021 occurred on Hydra. From January 2016 to March 2022, it is estimated that Hydra facilitated more than USD 5 billion in illicit transactions across the variety of products that it offered (United States of America V. Dmitry Olegovich Pavlov, 2022). However, there are no comprehensive surveys of drug use in Russia to properly estimate the market share of Hydra relative to traditional street trade. We conducted a series of four interviews with members of NGOs and investigative journalists to situate and contextualize our findings. The interviews were conducted over video calls in March-May 2022 and lasted 1 to 2 hours each. Our interviewees all confirmed

that Hydra was a common way to illegally buy narcotics in Russia, and was likely the most popular way in densely populated regions such as Moscow and Saint Petersburg.

In the online space, there are individual shops operating via Telegram groups and bots but these focus on selling drugs locally: in specific cities and districts. A small proportion of the drug trade continues offline, particularly amongst marijuana growers and economically disadvantaged opiate users who do not have access to the Internet. Our estimate based on interviews is that at its peak, Hydra may have accounted for more than two-thirds of the illegal drug trade in the largest Russian cities.

The stark difference between Hydra and its counterparts that operate in Western countries is the length of time it was able to continuously operate without intervention from law enforcement. Hydra operated for 7 years and was the dominant darknet market in Russia for much of this time. Relative to other popular darknet markets which rarely survive even a single year from inception, Hydra had the opportunity to evolve to dominate the Russian drug market in an unprecedented way. As a part of this, it developed a sophisticated organization and structure, established a set of rules and regulations for sellers and buyers, quality assurance mechanisms, and provided an escrow service. In addition, similar to legal online marketplaces, Hydra had a reputation system with buyers able to review sellers and products after a transaction. These reviews could then be used by future buyers to inform their choice of vendor. Somewhat surprisingly, it even advertised its free emergency telemedicine service to assist customers with medical issues related to the consumption of drugs.

While Hydra was primarily a drug market, it also facilitated the sale of other illegal and grey-market goods (forged passports, counterfeit documents and counterfeit money, SIM cards, etc.) and services (graphic design for the new shops on Hydra, use of private-access databases to find personal information about individuals). However, anecdotally these accounted for a substantially smaller proportion of transactions than drugs. The scope of illegal business was limited by the platform itself, which explicitly forbade selling guns, poisons, contract killing, explosives, government secrets, and pornography. In addition, drugs considered particularly dangerous, such as fentanyl and its derivatives, were also banned.

Another feature that distinguished Hydra from popular darknet markets in the US and Europe was the delivery method. The majority of darknet markets use mail orders with suppliers relying on either the post or legal couriers to send the disguised drugs. While mail delivery had previously also been popular in Russia, the introduction of a bill in 2014 requiring the postal service to inspect packages for illicit substances made this method of delivery less attractive (Saidashev and Meylakhs, 2021). As a result Hydra, similar to its Russian predecessor RAMP, operated via a dead-drop system. Couriers employed by vendors would hide drugs throughout the city prior to transactions taking place. The vendor would then list the type, quantity, approximate location, and price of the drugs on the Hydra website.

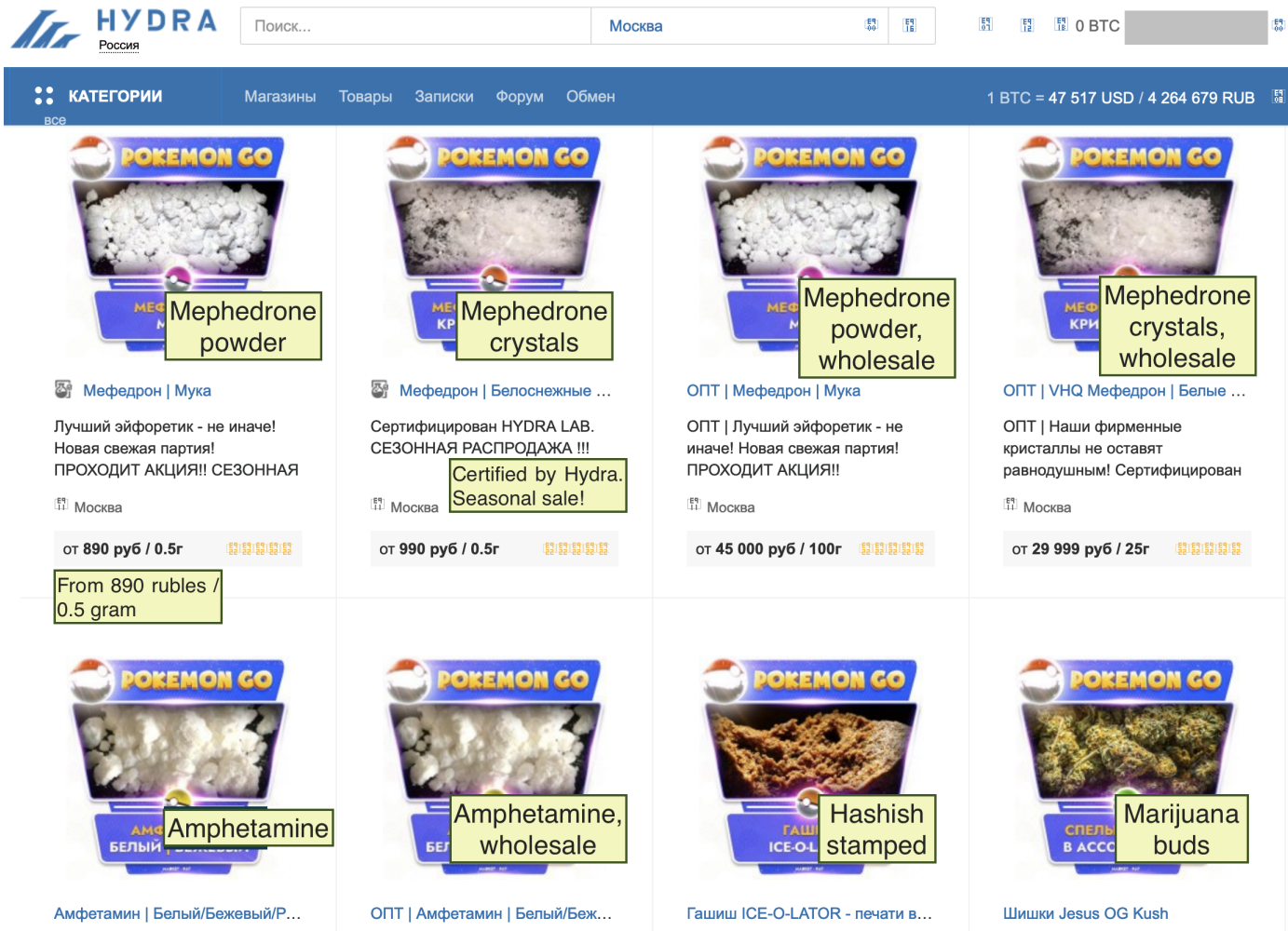
## 3 Marketplace Organization

### 3.1 Customers

Hydra was accessible on the Tor network via the use of the Tor Browser. After creating a temporary anonymous profile, a user could browse the website and filter available goods by drug type, shops, geography, price, and desired volume. For many product listings, there were reviews by other customers who provided feedback on the quality of the product and their experience.

Once a customer decides on the desired product, payment was made via Bitcoin. Customers generally had two options to deposit Bitcoin on the platform. One was to externally purchase the Bitcoin, which could then be transferred to the address provided by the marketplace. Another option was to use a QIWI wallet, a payment

Figure 1: The page of a Hydra vendor listing the types of drugs they sell in Moscow, 2021



service provided by the Russian financial company QIWI. As the company has ATM-like terminals throughout Russia, a customer can simply deposit cash to exchange it for Bitcoin using one of many cryptoexchange services, not necessarily affiliated with Hydra. Given that no identification is required for the use of the terminals, anonymity is ensured. Once the purchase was made, Hydra provided an escrow service holding the funds in an escrow account until the transaction was confirmed as having been successfully completed.

All communication between the buyer and seller occurred through the chat system on the Hydra website. After payment, the customer received detailed information on the location of the dead-drop, including photos and GPS coordinates. Thus, there would be no physical contact between the seller and the buyer; moreover, the communication between them was isolated by the website on the Tor network. The financial transaction was also anonymous provided the customer used Bitcoin or directly deposited cash to a QIWI terminal.

### 3.2 Delivery

As mentioned above, in contrast to many darknet markets, Hydra mostly operated through a system of *dead-drops*; the drugs were hidden in advance and buyers could see the type, quantity, and approximate location on

the platform. After payment, the customer was given the exact details necessary to collect the item. There were four methods used to hide packages: “magnet”, “dig”, “snow dig”, or “hiding”. The first involved attaching a magnet to the package and then sticking it to an object, such as the inner surface of a rain gutter. The second and third methods were burying the package in a suitable location, such as a park or public garden, in either soil or snow, respectively. Finally, the package could simply be hidden somewhere it was unlikely to be accidentally found (such as the attic in multifamily housing).

Additionally, instead of dead-dropping, some goods could be mailed after purchase similar to other darknet markets, although this was primarily used for drugs such as LSD that are particularly difficult for law enforcement to intercept.<sup>7</sup> Finally, many goods are also available for pre-order, which meant that they were not hidden prior to the transaction but were instead deposited after payment. Pre-orders were primarily used either for wholesale transactions or for exotic drugs.

As the communication between Hydra administrators, vendors, couriers, and customers was remote and anonymized, the marketplace served to mitigate many of the legal risks involved in drug transactions. However, placing and retrieving the dead-drop did expose couriers and consumers to the risk of detection by law enforcement. Activities such as digging in parks or searching the yards of multi-family houses became indications that someone was likely retrieving drugs.

### 3.3 Sellers

#### 3.3.1 Organization of business

Hydra provided an interface that allowed sellers to manage their business processes. Similar to other online marketplaces, Hydra allowed sellers to list a variety of goods for sale. However, Hydra also had tools that were tailored to the way the marketplace operated. In particular, it automated the assignment of dead-drops to couriers and the management of dead-drops.

In addition, Hydra provided accounting tools to keep records of costs and earnings. Finally, sellers had access to some analytical reports. Besides statistics related to sales, they could see, for example, statistics on each dead-dropper that worked for the shop.<sup>8</sup>

**Platform fees.** Hydra charged sellers for operating on the platform. As of March 19, 2022, the price the marketplace charged for starting a new shop was roughly USD 300. Additionally, Hydra also charged “rent” of USD 100 each month. This price had not changed since 2019 when it was reported by The Project (2019).

**Sales commission.** Hydra charged a sales commission that varied by drug type and value. For sales below 200,000 rubles ( $\approx$  USD 2,700) the fee was generally 5% of the purchase price. The commission was higher for certain drugs and could be as high as 10%.

**Workforce.** Some vendors on the platform had over 1,000 orders per day. Thus, the marketplace allowed each shop to have several workers. Workers could be of three types: administrators, operators, and couriers.

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<sup>7</sup>We find that the ratio of mailed listings to momentary listings is  $\approx 10\%$  for LSD and  $\approx 5\%$  for mushrooms, which is several times larger than the same ratio for other drugs. Unlike momentary listing, one mailed listing does not correspond to a particular district, and instead can serve the whole country. Thus, this ratio is likely to underestimate the proportion of mailed orders for these drugs. This is in line with the anecdotal evidence that mail was mainly used for psychedelics on Hydra.

<sup>8</sup>Monitoring statistics about couriers was important because of the arising agency problem: if a buyer reports that the drug was not found, this could be because the courier stole it or did not hide it securely, or because the buyer provides false information.

Administrators could assign roles to other workers, change the profile and the settings of a store, and conduct financial transactions. Operators served as mid-level management, e.g., responding to disputes and requests of customers. Finally, couriers could be hired on Hydra or elsewhere. In the former case, all transactions between them and the employer would go through Hydra.

### 3.4 Marketplace services

We base our description of the marketplace on several interviews with drug use related NGO activists and investigative journalists who studied Hydra. We have additionally studied manuals for customers and sellers from Hydra. These manuals were available at the Hydra website and provided extensive information about the operation of the marketplace.

#### 3.4.1 Reviews and ratings

Previous studies (see e.g., Janetos and Tilly, 2017) suggested that reputation is a crucial component of darknet marketplaces. Hydra allowed for two channels of buyers' feedback: ratings and reviews. Every time a buyer made a purchase, they were given 24 hours to leave feedback.<sup>9</sup>

The simplest information that potential buyers could use to evaluate the seller and item is the average rating. Hydra allowed for ratings between 0 and 10. Similarly to AlphaBay (see Červený and van Ours, 2019), SilkRoad (see Bhaskar et al., 2019), and other markets, most of the ratings on Hydra were very high. As can be seen in Table 5, the average rating is very close to 10, and the share of orders with a rating below 10 is just 4%. This may partly be explained by the fact that if the user did not post a rating during the 24 hours period, the marketplace automatically assigned a rating of 10 to the order. Users can see the average rating for the seller and the average rating for each of the items it sells.

The second component of the reputation system was reviews. According to the Hydra users we interviewed, reviews were an important factor in choosing between vendors. A typical review is a short message expressing satisfaction with a purchase. However, reviews often contain additional information: perceived quality of the drug, problems with the collection process, and missing items. Reviews could only be left after purchase to mitigate the risk of distortions due to fake reviews left by competitors. See Figure 2 for an example of reviews on Hydra.

#### 3.4.2 Dispute resolution

Hydra allowed buyers to initiate disputes. A typical dispute was related either to issues with the collection process or with the item purchased. Collection issues were typically related to situations where the drug was missing from the specified location or the collection was too difficult either for safety or access reasons. Problems with the item itself were generally due to either the quantity or quality being below what was advertised on the platform.

Disputes started with communication between the buyer and the seller through the internal messaging system. Typical outcomes were a refund, a replacement by providing information about another dead-drop, or a discount for a future purchase. If the dispute could not be resolved, one of the platform moderators read the messages and decided how to resolve the dispute.

Importantly, the moderators were much more likely to resolve a dispute in favor of the buyer if she or he had a long history of purchases without a high share of disputes. Thus, the system of disputes incentivized users to maintain an account instead of registering new ones.

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<sup>9</sup>The user could add additional comments to the review during the first 36 hours.



Figure 2: Example review page for a drug listing on Hydra

	<b>Combo</b>	вчера в 20:47	Yesterday at 8:47PM	Кокаин - Мексика
				Cocaine - Mexico
Сделок: 59		2 раз придумываю здесь, все супер!) Советую!) My second time with this shop, everything is perfect! Totally recommend!		
59 purchases				Москва
				Moscow
<hr/>				
	<b>Smoke8</b>	вчера в 10:34		Кокаин - Мексика
		Клад в касание, стафф как обычно на высоте 10/10		
Сделок: 514		Fast collection, the product is good as always, 10/10		
				Москва
<hr/>				
	<b>Kote5</b>	вчера в 00:56		Кокаин - Мексика
		все четко быстро укдно легко изи и качество хорошо , НЕ ПОДВЕЛ		
Сделок: 133		Easy collection and high quality, GOOD JOB		
				Москва
<hr/>				
	<b>Asd65</b>	25 Марта в 23:10		Кокаин - Мексика
		Почти в касание. Упаковка надежная. Вид, мука без камней. По качеству слабоват, но оценку не снижаю, надеюсь магазин подтянется, история то у вас большая, не портите ее. Всем добра.		
Сделок: 86		Fast collection. Sound packaging. The quality is a little low. I hope the shop improves. Good luck.		
				Москва

### 3.4.3 Hydra testing

Hydra also regularly published information on audits it had supposedly conducted on some of the items listed for sale. This testing was not universal and covered only a small subset of listed items within a given month. For example, only 47 tests were conducted in June 2021. Among them, 15 were in Moscow and 32 were in Saint Petersburg. In other months, tests were also conducted in several other cities. Vendors/items with a higher proportion of negative reviews or disputes were prioritized for selection. The tests were claimed to be blind, with the specialist not knowing the name of the seller. The test results were made public and posted to the marketplace forum. These results include an overview of the collection experience, a description of the packaging, the quantity relative to the advertised amount and the results of chemical testing. In particular, for drugs distributed as powder it was reported whether the purity meets the listed standard (e.g., VHQ or HQ). As well as providing buyers with additional information about vendors which could be used alongside reviews to reduce the information asymmetry present in an anonymous online marketplace, it may have served to directly incentivize sellers to maintain high standards given the risk of fines for failing the weight/quality tests.

### 3.4.4 Business model

There were several key sources of revenue for the platform. First, as mentioned above, Hydra charged sellers a fixed monthly fee in order to maintain a store on the platform. Second, Hydra collected a commission from all transactions on the marketplace. Third, Hydra auctioned off the right to have a store ad listed on the main page

of the website. Finally, Hydra sold special statuses to larger sellers on the market.

**Front page.** The largest sellers could buy one of the 20 paid positions on the main page of the website. These positions were distributed through a first-price auction, with the highest bidder getting the first position, the second highest bidder getting the second position, etc. The bids could be observed by store owners. The Project (2019) reports that the cost of the positions on the main page was on the order of magnitude of tens of thousands of USD by the time the article was written.

**Fines.** Hydra could also charge a seller a penalty if they broke the rules of the platform. The size of the penalties ranged from 25,000 rubles (approximately USD 340,<sup>10</sup> which was the penalty for hiding dead-drops too close to each other) to several hundreds of thousands of rubles. The largest penalties were related to maintaining the monopoly position of the marketplace. Stores were not allowed to invite clients to buy drugs outside of the platform or register on other marketplaces.

### 3.4.5 Special statuses

**Trusted sellers.** Hydra allowed merchants to obtain the status of a “trusted seller”. The status cost USD 1,000 per month and could be purchased if the following two requirements were satisfied: the seller had more than 1,000 sales overall and had a dispute rate below 7%. The status increased perceived reliability from the point of view of buyers. It also improved its position in search results. In addition, trusted sellers could make decisions in the dispute procedure before Hydra’s moderators reviewed it.<sup>11</sup> Finally, trusted sellers were allowed to have franchisees, that is, small partners who produce synthetic drugs or grow marijuana, and partner with the seller using Hydra as the mediator.

**Certified producers.** In the case of synthetic drugs, the marketplace allowed sellers to obtain the status of a certified producer. For buyers, the status should signal the relative safety of the items purchased. For sellers, it should increase sales as users could filter search outputs only to show certified producers.

This feature of the marketplace is unique in the degree of involvement of the marketplace it implies. Based on the description on the website, Hydra would check the whole production cycle: the chemical reagents bought and used, the equipment, and the qualifications of the workers. The marketplace also claimed to test the final product in its lab. It is not clear from the description whether the Hydra employees conducting these tests physically visited the production facilities. The platform stated that Hydra required photos of the production facility and detailed information regarding it (e.g., the reagents purchased) as part of the application for this status. The cost of the status was an additional 3% of all sales.

## 3.5 Other services

### 3.5.1 Professional education

Hydra also hosted a page called “School of dead-droppers”, where it sold a few online courses for couriers and services for resolving employee-employer disputes for shops. Based on the reviews, the training sold by Hydra was credited with reducing the risks associated with leaving dead-drops. Hydra also provided consulting services for

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<sup>10</sup>Here and below, we use the exchange rate for May 2020, roughly equal to 74 rubles per US dollar.

<sup>11</sup>For sellers without the status, proceeds from disputed sales were held by the system until a decision was made by a moderator.

aspiring producers. The services were stated to range from helping with the purchase of precursors and equipment to the education of production facility workers.

### 3.5.2 Medical help

Hydra provided free telemedicine consultations for people who use drugs. In particular, the platform actively advertised employment for medical professionals for this service. The consultations occurred either through the chatbot in the Telegram messaging service, the website messenger, or on the platform's forum. Presumably, questions asked by customers could be related to overdoses and other instances of sickness following the consumption of drugs. That said, it is hard to evaluate the popularity or efficacy of Hydra's telemedicine services.

## 4 Marketplace Analysis

### 4.1 Data

For our quantitative analysis, we use two complementary datasets. The first dataset is a set of drug listings scraped from the Hydra website. The dataset contains daily snapshots of all drug listings across all sellers on Hydra from April 1, 2020 to May 2, 2020. For each listing, we observe the characteristics related to the product and its delivery method. The former includes the type of the drug, the amount, the price, the name and the title of the listing, and the name and the ID of the seller. Information on delivery includes whether the listing is a preorder or a momentary listing, and whether the order is mailed. For momentary listings, we observe the type of hiding and the approximate location of dead-drops. In total, the dataset contains 31,035,506 listings. This dataset has also been used in several journalist investigations (Knife Media, 2020; The Project, 2019). Scraped listings from Hydra have also been used in studies of drug use, and opiate listings were shown to be significantly correlated with fatal drug overdoses (Vlassov et al., 2021).

The second dataset we use is provided by a data provider established in Pennsylvania, USA. This firm continuously collects data from the world's largest darknet marketplaces. Details about the project can be found in Soska and Christin (2015). This dataset allows us to see a large subset of the reviews left on the platform. For each review, we observe the item for which it was left, the vendor, the nickname of the buyer, the time of the review, and the associated numerical rating that the buyer has given.

### 4.2 Drugs sold

Table 1 shows the composition of dead-drop listings on Hydra in April 2020. The original dataset contains 31,035,506 listings. These are daily snapshots of the entire universe of drug listings on Hydra for 31 days. First, we remove all preorders and mail-based listings, which leaves us with 2.8 million dead-drop listings, which are the listings of drugs that were already hidden and ready for pickup. However, listings for the same package will appear multiple times as they were listed each day until purchased. Thus, we remove duplicate listings at the drug-vendor-quantity-location level. We end up with approximately 417,000 unique dead-dropped drug listings during April of 2022. The majority of the drug listings are for either stimulants or euphorics.

Note that one listing on the website can represent several dead-dropped packages with the same characteristics hidden in the same general location. Therefore, this table likely underestimates the actual number of drug packets hidden throughout Russia. The Project (2019) suggests that the true number might be as much as 5 times higher. Hence,  $\approx 417,000$  is a conservative lower bound of the number of drug packages lying hidden in Russia during April 2020. In comparison, Bhaskar et al. (2019) observe less than 25,000 drug listings at the peak of major western

Table 1: Unique listings of dead-drops on Hydra from 1 April - 2 May 2020

Drug	#	%	Drug	#	%
<b>Stimulants</b>	<b>172,704</b>	<b>41.4</b>	<b>Psychedelics</b>	<b>16,253</b>	<b>3.9</b>
Amphetamine	55,916	13.4	LSD	5,709	1.4
Alpha-PVP	52,297	12.5	NBOME	3,189	0.8
MDMA (ecstasy)	40,937	9.8	Mushrooms	3,052	0.7
Cocaine	20,538	4.9	Sodium oxybate	2,818	0.7
Methamphetamine	2,969	0.7	Dissociatives	573	0.1
Other	47	0.1	2C-*	452	0.1
<b>Euphoretics</b>	<b>131,540</b>	<b>31.5</b>	Other	460	0.1
Mephedrone	131,341	31.5	<b>Opiates</b>	<b>9,645</b>	<b>2.3</b>
Other	199	0.1	Methadone	6,113	1.5
<b>Cannabis</b>	<b>76,067</b>	<b>18.2</b>	Heroin	3,326	0.8
Marijuana buds	36,260	8.7	Other	206	0.1
Hash	34,801	8.3	<b>Synthetic cannabis</b>	<b>6,309</b>	<b>1.5</b>
Marijuana leaves	3,253	0.8	Hard mix	4,814	1.2
Marijuana oil and extracts	1,319	0.3	Soft mix	934	0.2
Other	434	0.1	Cannabinoids	561	0.1
⋮	⋮	⋮	<b>Quasilegal and RX drugs</b>	<b>3,842</b>	<b>0.9</b>
			<b>Precursors (DIY)</b>	<b>796</b>	<b>0.2</b>
			<b>Other</b>	<b>249</b>	<b>0.1</b>
			<b>Total</b>	<b>417,405</b>	<b>100</b>

darknet marketplaces such as Silk Road, Silk Road 2.0, Evolution, and Agora. However, given the definition of a listing is substantially different on Hydra compared to most other darknet markets, a more meaningful comparison may be the number of sellers on the platform. Using this metric, Hydra still appears to have been substantially larger than the major western darknet marketplaces as we observe 4,907 unique sellers on the platform in our single month of data compared to the 2,604 sellers on Agora observed by Bhaskar et al. (2019) over a much longer period from December of 2013 to August of 2015.<sup>12</sup> Given the finding of Soska and Christin (2015) that darknet sellers are on average active for just 220 days, this comparison likely underestimates the extent of the difference in size between Hydra and the major western marketplaces.

Table 2 shows summary statistics for several of the main drugs on Hydra. One interesting feature is that heroin was a very small proportion of this market. While it was allowed to be sold on Hydra, our interviewees have suggested that heroin was an exception among other drugs, and the majority of the heroin trade in Russia occurs through more informal methods such as bots on Telegram or offline and on the streets. The remaining drug types were widely available, many being sold in around 500 different cities and towns. Unlike most other darknet marketplaces, a large proportion of listings on Hydra appear to have been intended for redistribution. Demant et al. (2018) estimate that just 2.1% of transactions on Agora and The Silk Road 2.0 were wholesale transactions, defined by having a value above USD 1000, with the remainder appearing to be for either personal

<sup>12</sup>Bhaskar et al. (2019) collected data for over a year and observed lower numbers of sellers on the other major marketplaces: 902 on The Silk Road, 796 on Silk Road 2.0, 1,754 on Evolution, and 1,836 on Nucleus.

Table 2: Summary statistics for select drug types on Hydra

	Alpha-PVP	Amphetamines	Cocaine	Ecstasy	Marijuana	Methamphetamine	Heroin
# of Sellers	1,513	1,621	639	1,299	1,655	127	145
# of Cities/Towns	741	589	352	516	482	114	185
Median Price (USD per gram/unit)	31	13	127	9	22	19	59
Average Price (USD per gram/unit)	35	15	126	13	24	32	65
Average Daily Number of Listings	9,484	16,810	5,535	14,103	4,438	766	1,158
Average Daily Total Quantity Listed (grams/units)	59,131	368,501	17,520	344,627	33,192	22,230	6,022
Average Daily Total Value of Listings	837,594	4,786,341	1,603,401	1,642,807	493,021	99,885	208,269
Median Quantity (grams/units per listing)	1	2	1	3	2	2	1
Average Quantity (grams/units per listing)	6.24	21.92	3.17	24.44	7.48	29.02	5.20
Average Daily Number of Wholesale Listings	115	311	237	267	75	25	16

*Note:* Summary statistics for “momentary” listings on Hydra, those which have already been dead-dropped at the time of listing. “Wholesale” is defined as listings with a price above \$1000.

consumption or social distribution. Using this definition, we find that for the categories listed in Table 2 the proportion of wholesale listings varies from  $\approx 40\%$  for Alpha-PVP to  $\approx 15\%$  for heroin. Restricting our data to instantaneous orders (i.e., excluding pre-orders) we find that the proportion of wholesale listings drops to 1 – 5% for the categories in Table 2. Hence we conclude that the majority of these business-to-business transactions occurred through pre-orders and this inference is corroborated by several of our interviewees.

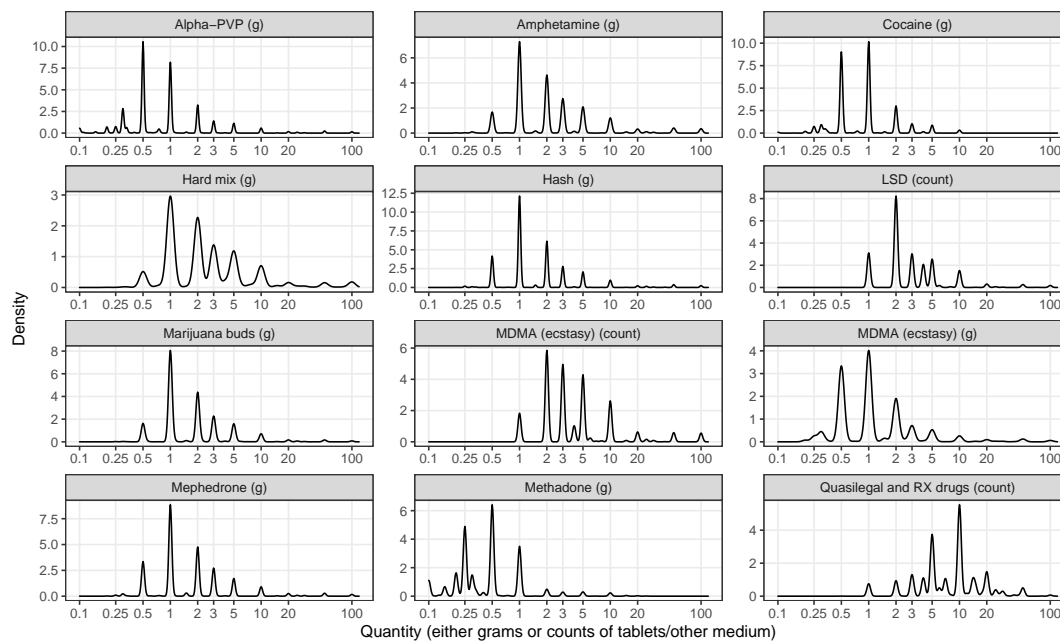


Figure 3: Kernel density estimates of quantity distribution for most frequent drugs in unique momentary listings. Quantity is represented either in grams (g) or counts.

Finally, Figure 3 shows the weight/quantity distribution of several types of drugs. It is apparent that the most frequent quantities are 0.5, 1, 2, 3, and 5 grams for most of the drugs. Quasi-legal and RX drugs, such as Xanax, are sold as tablets, and therefore have higher quantities. Interestingly, methadone is rarely sold in weights above 1 gram.

## 4.3 Geography

### 4.3.1 Within-city dispersion

Given that our interviews mentioned that the convenience of the pick-up location was a key factor to differentiate between listings, the distribution of listings across the different neighborhoods of a city reflected the spatial distribution of demand. Figure 4 shows the share of three major drug categories as a proportion of all drug listings within each district of Moscow. As can be expected, cocaine is generally hidden in the city center around the business districts. At the same time, cheaper drugs such as synthetics and marijuana, are proportionally much more popular in the outskirts. Similar patterns can be seen in other major cities throughout Russia.

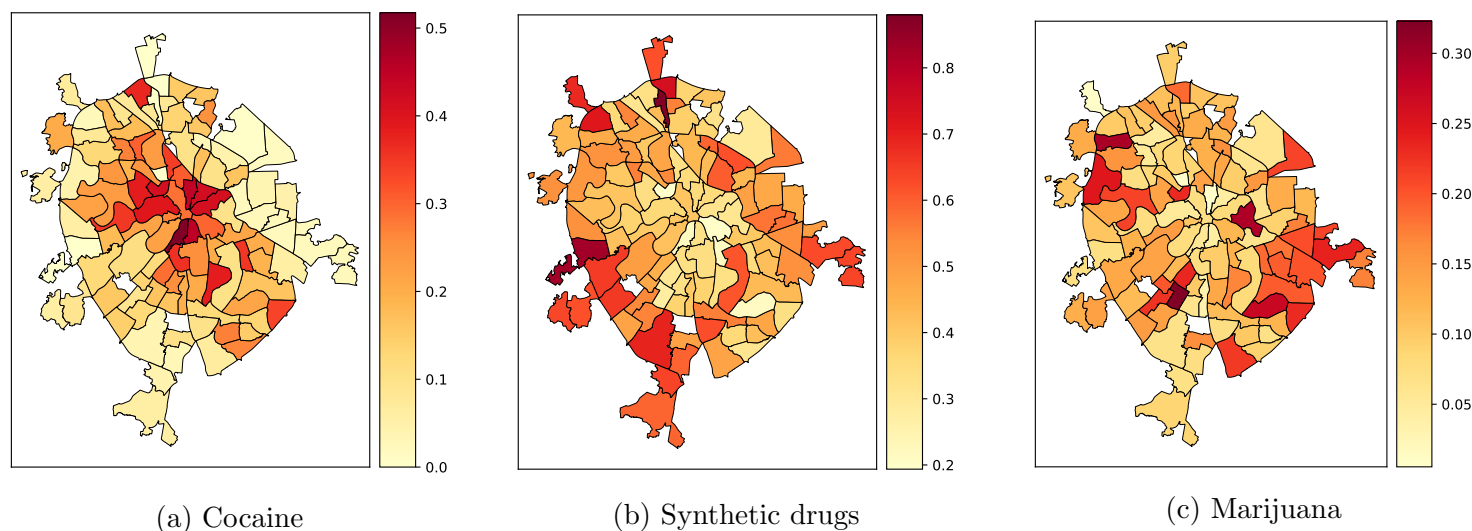


Figure 4: Map of Moscow showing the proportion of listings of the given drug type as a proportion of the total number of drug listings in that neighborhood. Synthetics include Methamphetamine, Amphetamine, MDMA, Alpha-PVP, MDPV, and mephedrone. Only municipal districts are included.

### 4.3.2 Between-city dispersion

With Hydra operating in 1,129 settlements across every region in Russia, over 100 million people live in a settlement that had at least one dead-drop available for purchase on Hydra in April 2020. This means that of the 144 million inhabitants of Russia, 69% had access to drugs from Hydra in their city or village.

Figure 5 shows the distribution of cities with at least one momentary listing from Hydra. Moscow and Saint Petersburg, being the most densely populated cities in Russia, on average had 3 and 9 dead-drops per 100 residents, respectively. Among the less populated cities, Sochi stands out as one of the cities with the highest demand with 16 listings per 100 residents, likely related to its popularity as a resort location. Finally, many smaller satellite cities around Moscow (such as Aprelevka or Solnechnogorsk) have a particularly high number of listings per capita. These locations are likely to be convenient for hiding drugs and thus serve some consumers from Moscow.

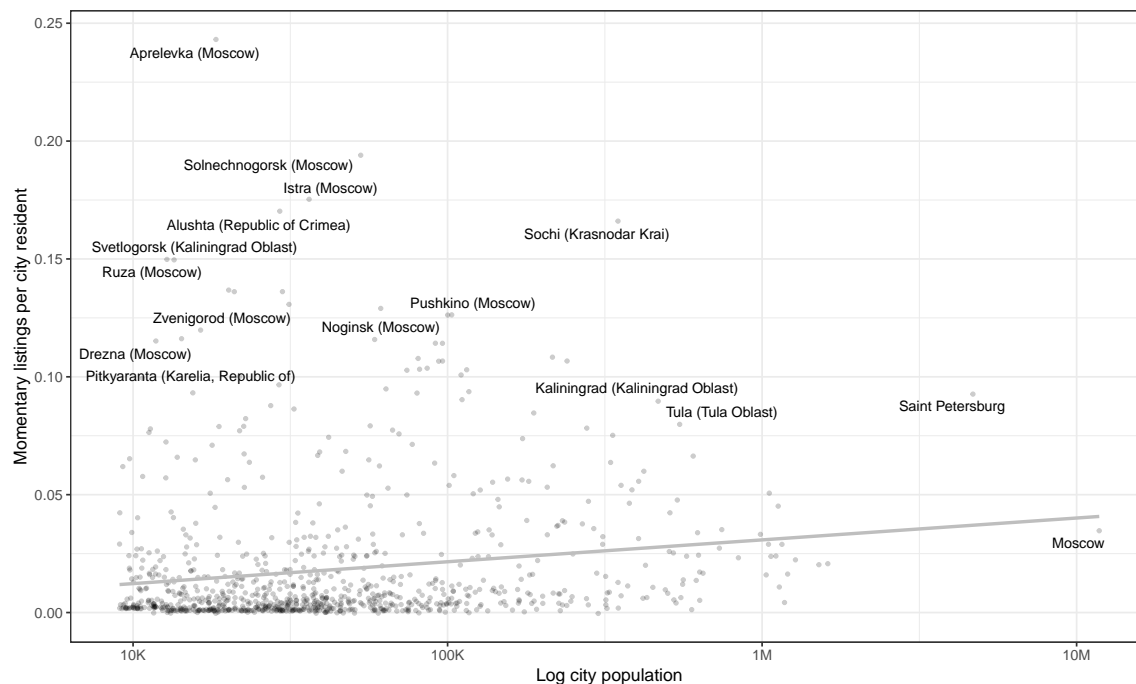


Figure 5: Momentary listings per resident in Russian cities with a population >10K. The grey line shows a linear fit.

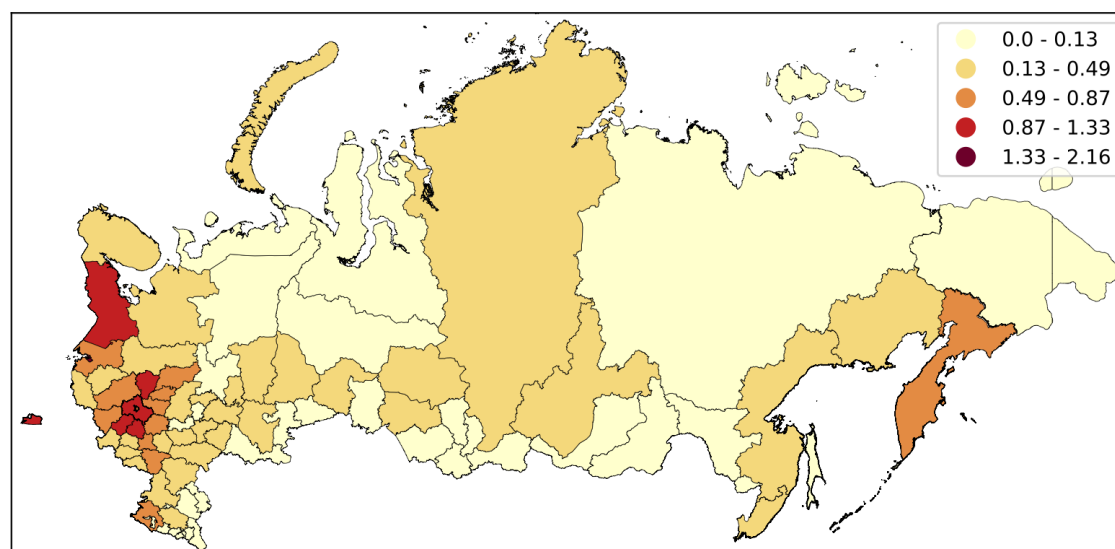


Figure 6: Daily listings per 1,000 citizens.

Figure 6 shows the distribution of activity on Hydra across regions. Several groups of regions seem to have more listings per capita than others: first, Moscow, the most populated city in the country, and its neighboring regions such as Moscow Oblast, Kaluga Oblast, Tula Oblast, and Vladimir Oblast. The map also supports the view that drugs are more accessible in regions adjacent to major ports (for example, Saint Petersburg) and having a long border (for example, the Republic of Karelia and Krasnodar Krai). The regional coverage by Hydra also

reflects the population density, with more people living in the European part of Russia and in the southern parts of Siberia.

## 4.4 Market concentration

More than 4,500 shops operated on Hydra in April 2022. This number itself suggests a highly competitive market. To quantify the degree of competition, we analyzed the characteristics of shops: the number of listings they usually had, how many cities and regions they operated in, the extent of specialization, and to what degree the market is concentrated in general.

Ideally, we would estimate the market share of sellers using data on the number of transactions conducted on the platform. Unfortunately in our data we only observe listings and thus must use the number of listings to infer transactions. However, we posit a strong correlation between momentary listings and transactions: momentary listings represent drug packages that have already been hidden, retrieving such packages is costly, and there could be a potential loss if these packages are left for a long period without being sold. Thus, we sum the prices of each listing and obtain an estimate of the volume of a single shop, which is the total cost of all the listings in USD. We use this estimate to then calculate the share of each shop as a proportion of the total sum of volumes.

Table 3: Market concentration by most popular types of drugs. Data: all unique retail (listing price < USD 1000) “momentary” listings in April 2020

Drug type	# of sellers	Retail volume, USD	Share of total volume	HHI
Mephedrone	2,649	6,169,398	0.27	0.007
Amphetamine	1,733	2,982,659	0.13	0.009
Cocaine	670	2,855,486	0.12	0.028
MDMA (ecstasy)	1,372	2,297,219	0.10	0.012
Alpha-PVP	1,604	2,215,938	0.10	0.007
Hash	1,567	2,149,458	0.09	0.006
Marijuana buds	1,735	2,005,045	0.09	0.004
Across all drugs	4,676	22,936,026	1.00	0.004

To quantify the degree of market concentration on Hydra, we calculate the Herfindahl-Hirschman Index (HHI) using the set of unique dead-drop listings in April 2020 (see the data description in Subsection 4.2) which were subset to omit wholesale listings and listings with artificially inflated prices.<sup>13</sup> Thus, we only include listings with a price lower than USD 1,000 (this removes 6,000 listings out of 417,000). HHI is a measure of market concentration ranging from  $\approx 0$  (perfect competition) to 1 (monopoly). A value below 0.15 is generally considered to suggest a competitive market. Overall, on Hydra we observe an HHI of 0.004, indicating a competitive market.

Looking in more detail at the characteristics of the largest and typical sellers on Hydra, the seller with the largest retail volume in the data, the shop “Prazdn1k” [Holiday] has 4,527 listings with a total value of USD 471,096, which is 2% of the whole retail volume on the platform in that month. The shop “Prazdn1k” was selling 9 types of drugs, with the majority of their listings being mephedrone or cocaine, and operated in 34 regions and 54 cities.

<sup>13</sup>Some stores appear to use “holding” prices when they exhaust their inventory. Rather than removing a listing, they would instead set a price so high that no consumer would attempt to purchase the listing.



The shop with the second largest volume, “PokemonGo”, had the largest number of unique listings (5,416) with a total value of USD 406,577. It was active in 45 regions and 102 cities and sold 8 different types of drugs, predominately mephedrone and amphetamine. All other sellers had market shares of 1% or less, with 30% of all shops having had less than 10 unique listings in total during the month we analyze. The median seller on Hydra is relatively small: it worked in one or two cities, had just 10 listings per drug type, and sold 1-2 types of drugs.

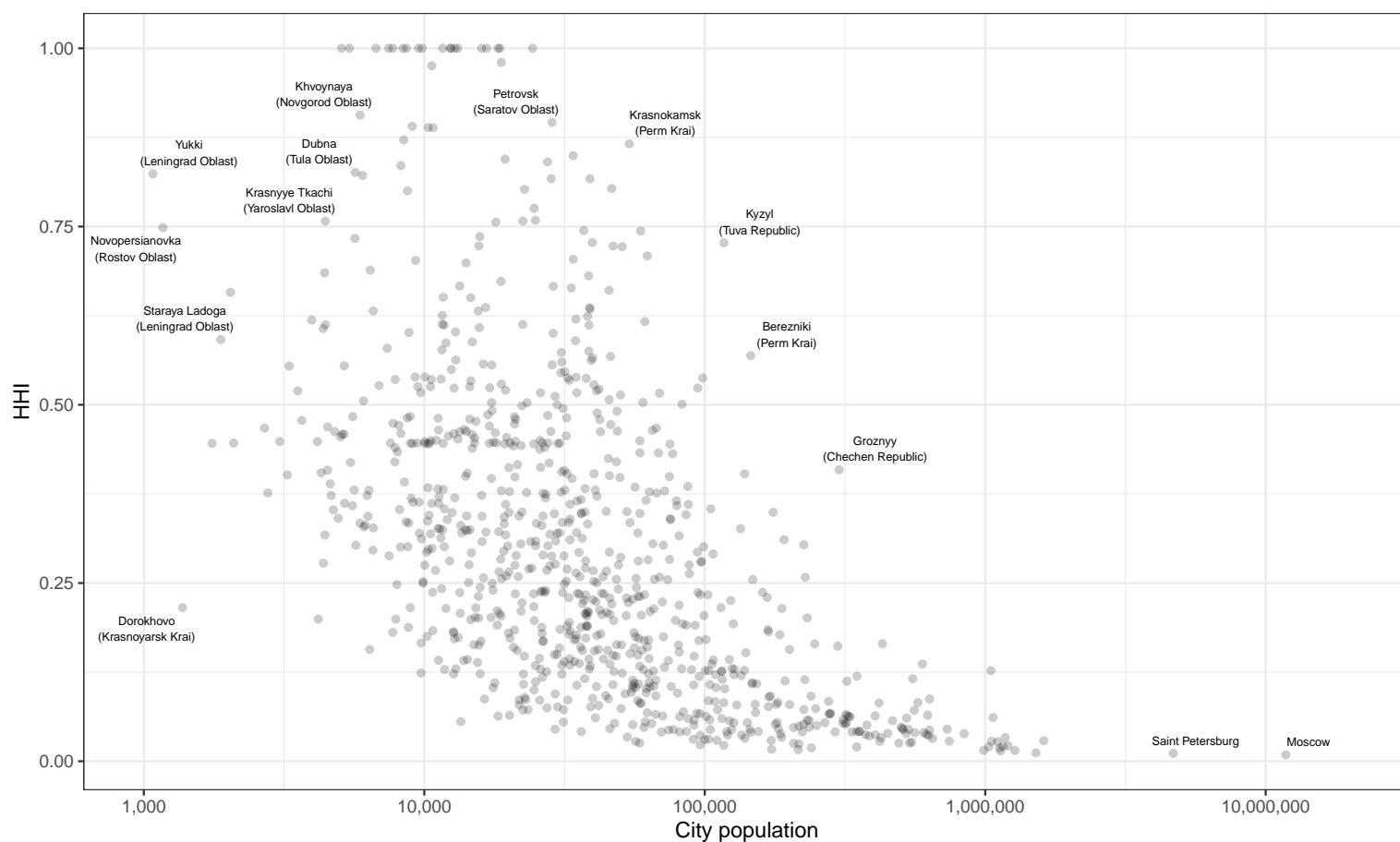


Figure 7: Market concentration in Russian cities, towns, and villages.

We also separately calculate HHI for the most popular drugs and cities on Hydra. The markets for cocaine (HHI=0.027) and mephedrone (HHI=0.014) appear to have been the most concentrated markets on Hydra, yet in absolute terms, they are still competitive (Table 3). If we look at the sellers in each of the cities, we observe the direct relationship between the population of the city and the market concentration (Figure 7). In large cities, the HHI is low and the online drug market (judging by the Hydra data) was competitive. In smaller settlements, there is substantial variation in competitiveness and several appear to have been monopolies in terms of presence on Hydra.

## 4.5 Price decomposition

Within a given store, pricing on Hydra tended to be non-linear with per-unit prices decreasing as order size increased. While part of this non-linearity is driven by wholesale transactions where dealers buy from larger

suppliers, there were also fixed transaction costs imposed on suppliers as a result of the illegal nature of the market. The main component of this fixed cost is the dead-drop cost. Given the high risks faced by couriers in hiding drugs, compensation for these couriers represents a substantial proportion of the cost of a transaction, one which is relatively invariant to the number of drugs hidden. In order to disentangle this, we use the following strategy.

In Section 4.4, we document a very high degree of competition between sellers on Hydra. In a competitive market, the price that sellers set should be equal to the total cost of supplying the good. This includes the cost of raw materials, the time of participants as well as compensation for the legal risk which participants take. These costs can be split between the cost of delivery and the cost of purchasing or producing the drug. As Hydra was also a large market for employment (see Section 3.3.1), we expect the delivery cost to be approximately uniform across sellers. Further, if there was no product heterogeneity within each drug type and sellers produced the drug with similar technologies or purchased it on the same competitive market, then the per gram cost should be the same for each seller. Under these simplified assumptions, the price set by sellers should be given by the formula

$$price = DC + PGC \times weight,$$

where  $DC$  is the delivery cost, and  $PGC$  is the per-gram cost. Motivated by this simplified economic model, we run the below regression, allowing the fixed cost of dead-drops to vary depending on the drug type. That is, for each drug type we estimate the regression

$$price_i = \alpha + \beta \times weight_i + \gamma_{s(i)} + \epsilon_i,$$

$$\sum_s \gamma_s = 0,$$

where the sample consists of all listings  $i$  for this drug. We also include seller-level fixed effects  $\gamma_{s(i)}$ , where  $s(i)$  is the seller selling listing  $i$ . We specify the fixed effects to sum to 0. In this model,  $\alpha$  has the interpretation of the average fixed cost, which we expect to reflect the costs of hiding a dead-drop. The per-gram costs of a particular drug are given by  $\beta$ . The seller-level fixed effects capture possible variation in costs and prices across sellers.<sup>14</sup> We restrict estimation to small retail listings.

The results for Moscow are shown in Table 4. Each column reports the results for a different drug type. For cocaine, shown in column (1), we see that on average each additional gram of cocaine increases the price of a listing by USD 97.5. The fixed cost of a listing of cocaine is on average USD 32.42 which we attribute primarily to the cost of having a courier perform the dead-drop. The numbers we see are comparable in magnitude to the numbers our interviewees suggested when we asked how much couriers earn on Hydra per dead-drop. Finally, the obtained  $R^2$  is very high for all drugs, which provides some support for the chosen linear specification.

Table 4 reveals two properties of the fixed-cost components of prices on Hydra. First, the fixed effects in the regressions are different for different drugs. We believe that this reflects that delivery costs for different drugs are different. For example, cocaine dead-drops are the most expensive because they appear to be the most difficult to make for several reasons. First, cocaine is typically hidden in central areas (see Figure 4), where policing is more intense and thus the risks for couriers are higher. In addition, cocaine dead-drops can be expected to be of higher “quality”: the cost of losing a dead-drop of cocaine is higher and hence the packages should be hidden better. Finally, the risk of couriers absconding with drug packages appears to have been a significant concern for shops and the higher street value of cocaine packages makes them particularly susceptible. Hence, couriers were provided higher compensation per package in order to incentivize them not to steal the drugs.

<sup>14</sup>The results are robust to removing fixed effects from the specification.

Table 4: Fixed cost and marginal cost

	(1) Cocaine	(2) Buds	(3) Hashish	(4) Amphetamine	(5) Mephedrone	(6) Heroin
Weight	97.50*** (0.101)	19.71*** (0.0468)	17.72*** (0.0532)	7.671*** (0.0133)	13.24*** (0.0224)	36.09*** (0.108)
Constant	32.42*** (0.221)	13.75*** (0.111)	17.26*** (0.150)	17.16*** (0.0793)	15.84*** (0.0789)	14.02*** (0.0971)
N	44558	15666	17862	50536	12726	3151
R <sup>2</sup>	0.955	0.921	0.864	0.868	0.965	0.973

Standard errors in parentheses

Only retail listings with at least one review for the product are used

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

The second property we observe is that the estimated fixed costs are high relative to the estimated per-gram costs. We can see that the dead-drop cost represents a substantial component of the cost of a small listing. For example, comparing these findings with the median quantities from Table 2, we find that for cocaine the cost of delivery comprises around one-third of the cost for the median dead-drop. For amphetamine, the delivery cost is more than half of the cost for the median dead-drop. This suggests that while the market has adapted, the Russian laws introducing more stringent scrutiny of posted packages has still somewhat served to inhibit the online drug trade by increasing price and thus implicitly decreasing the quantity demanded.

### 4.6 Reviews and ratings

Table 5 presents the distribution of ratings that users leave after purchases. Similar to what was documented for other darknet marketplaces (Bhaskar et al., 2019), ratings on Hydra predominately took the maximum possible value. Despite that, our interviews consistently describe that reputation was important on Hydra, in particular, for consumers choosing between vendors. We conclude that the review text was more important, as opposed to relying on the rating. For example, the fourth review in Figure 2 is critical of the product, stating that “the quality is not good enough” yet still rates the item 10/10.<sup>15</sup>

Rating score	Share
10	96.0%
8-9	1.3%
5-7	1.2%
1-4	0.7%
0	0.8%
Mean rating	9.8

Table 5: Distribution of user ratings on Hydra.

<sup>15</sup>While ratings are given out of 10, when displayed next to reviews they were converted to a rating out of 5.

## 5 Policy Implications

As was mentioned above, Hydra presents a unique counterfactual example of a marketplace that was given scope to evolve and grow for a long time. This case allows us to understand from another angle the effect of the shutdown policies that are currently being used. What are the implications of such shutdowns given that otherwise these small darknet marketplaces could reach the scale of Hydra? Before we discuss the implications of our analysis for policy, we need to describe the aftermath of the shutdown of Hydra.

### 5.1 Consequences of shutdown

In this section, we provide a brief description of what happened to the Russian drug market after the shutdown of Hydra on April 5, 2022. This discussion is primarily based on media reports and anecdotal evidence, as darknet traffic is by its nature not observable and there is no data available that was scraped from any of the marketplaces which arose after Hydra.

In the initial days after the shutdown, buyers and sellers attempted to trade using the two darknet forums that had been popular among Hydra users: LegalRC and RuTor. In addition, sellers began actively using their own websites or bots on Telegram messenger as a communication channel for selling drugs.<sup>16</sup> Despite Telegram bots remaining popular, the demand for a centralized platform quickly led to the emergence of a large number of relatively small darknet marketplaces over the following weeks. Among the largest new marketplaces are “OMG”, “Blacksprut”, and “Mega”. At the moment, there is no evidence that any of them is close to obtaining the same share of the market that Hydra had. For example, on October 16, 2022, “OMG” had 3,343 stores displayed on the website. While this is similar in scale to the 4,907 sellers we document for Hydra in Section 4.2, it is clear that the marketplace is nonetheless substantially smaller than Hydra had been: the largest shop on “OMG” has only 11,858 fulfilled orders<sup>17</sup>, which is less than a tenth of what the largest shop on Hydra was selling monthly.

It has also been reported that the emergence of several competing platforms spurred a series of DDOS attacks on each of them (Lenta.ru, 2022). These attacks alongside the lower technical capacity of these platforms have meant that they have struggled to support a large number of visitors and they are considered to be much slower and less convenient than Hydra. The fact that individual marketplaces will regularly be inoperable forces market participants to operate on multiple marketplaces. This increases search costs for consumers, requiring that they spend time locating multiple marketplaces and suitable sellers on each marketplace. For sellers, this increases their administrative costs due to the additional management effort required to operate on multiple platforms.

The implications of the closure have extended beyond merely a reduction in “convenience”. As mentioned in Section 3.4.1, the reputation mechanisms of darknet markets are an important feature that allows these markets to operate in a context that would otherwise give rise to significant moral hazard. However, in the new volatile environment, sellers have less incentive to sustain a positive reputation relative to when Hydra was the de facto monopolist. Reports of fake listings where drugs are not deposited are considered more common and concerns about drug quality have increased. These problems are exacerbated by the lower functionality of these platforms. For example, users report a lack of reliable moderation on these platforms, which alongside the less reliable reputation/history of participants inhibits the possibility of having disputes satisfactorily resolved.

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<sup>16</sup>As is discussed in Section 3.4.4, selling outside of the marketplace was forbidden by the rules of Hydra. Thus, before the shutdown the largest shops on Hydra could not operate elsewhere under the same brand.

<sup>17</sup>Screenshots are available upon request.

## 5.2 Policy trade-off

The case of Hydra demonstrates that a darknet marketplace that is allowed to grow without interruption can dominate the market, reaching an extremely large size and high level of sophistication. The consequences of this outcome are crucial for determining how much governments should invest in preventing it. We believe that the counterfactual of Hydra highlights the key costs of such an outcome and illustrates the trade-off that governments face when choosing whether to invest in shutting individual darknet marketplaces down. We start with listing the arguments supporting the shutdown of growing darknet marketplaces.

1. **Large marketplaces increase demand for drugs.** The Federal State Statistics Service reports an increasing number of overdose deaths in Russia in 2020 and 2021, with experts citing Hydra as a crucial factor (Meduza, 2022). Intuitively, consumption increases when a single large marketplace exists for a long time. In particular, the presence of a large darknet marketplace decreases many of the salient costs of consuming drugs. A single well-known platform decreases the search costs for consumers wishing to enter the market. This holds not just for consumers who were inexperienced in drug use but also those who wished to consume new drugs types or consume drugs while away from home, given the wide variety of drugs types (see Section 4.2) and cities (see Section 4.3) on the platform. In addition, Hydra was more convenient to use than smaller marketplaces, providing consumers with a well developed website that was fast and reliable. This reliability was seen to decrease the risks consumers inherently face in an illegal market. The risk of exit scam was low, thus reducing the possibility that users would lose funds deposited on the website. Meanwhile, the effect of marketplace-provided moderation in combination with a reputation system founded on a long history of operation reduced the risk of being scammed by a seller.
2. **Large marketplaces increase the supply of drugs.** We find that Hydra had a substantial number of wholesale drug listings (see Table 1). We also document that precursors were actively traded on Hydra. Finally, Hydra had job listings for individual producers, such as chemists to synthesize drugs and marijuana growers. This suggests that a large darknet marketplace facilitates communication between agents on the supply side of the drug market. This is in contrast with the smaller darknet markets which have historically operated in the West where supply-side interactions were less common (see Section 4.2 for details).
3. **Competition between marketplaces promotes destructive attacks.** As described in Section 5.1, after the shutdown of Hydra the emerging marketplaces have engaged in a sequence of DDOS attacks on each other as they vie for dominance. This competition itself serves to destabilize the online illegal drug trade without requiring the government to actively commit resources.

The reasons above highlight the strong negative effects of allowing a large dominant marketplace such as Hydra. However, there are also important arguments against directing drug enforcement resources towards aggressively shutting down darknet marketplaces, and instead allowing the development of a single dominant marketplace.

1. **New markets quickly emerge after a shutdown.** Multiple new marketplaces emerged several weeks after Hydra was shut down (see Section 5.1). This mirrors the experience of the Western world, where users quickly migrated to substitute markets shortly after shutdowns (see Bhaskar et al., 2019 and Soska and Christin, 2015). This fact substantially limits the long-term effect of shutdowns.
2. **Reputation system increases the quality of drugs.** In Section 3.4.1, we describe the importance of reviews and ratings for consumers choosing a vendor on Hydra. Previous studies have also highlighted importance of reviews and reputation on darknet marketplaces (see Espinosa, 2019; Hardy and Norgaard,

2016; Aldridge et al., 2018; Bhaskar et al., 2019). The substantially longer history of Hydra and a greater number of transactions meant that reputation served as a substantially more informative signal on Hydra than other marketplaces. This allows consumers to better differentiate between sellers who sell purer drugs and those who may use dangerous adulterants. In addition, it would increase equilibrium quality beyond that of smaller marketplaces as the incentive to maintain a good reputation is stronger. Thus, a large monopolist marketplace can increase the quality of drugs, which in turn can improve health outcomes for consumers who otherwise would purchase drugs elsewhere.

3. **Large marketplaces have incentives to self-regulate.** In Section 2.2, we report that Hydra forbade selling guns, poisons, contract killing, explosives, government secrets, and pornography. Importantly, it also forbade selling fentanyl and other drugs considered too dangerous. Hydra also claimed to audit the quality of drugs sold on the platform (see Section 3.4.3) and had representatives that supposedly provided medical consultations. This highlights that a large darknet marketplace has more incentives to regulate participants on the platform and be concerned about its reputation. For example, a large marketplace has greater incentives to mitigate the risks of overdose or arrest for its users because it can expect to extract profits from them in the future (unlike a small marketplace operating in a fragmented market, which would observe only a small probability for a given user to return). Thus, a large marketplace to some extent internalizes harms to its users. A reduced focus on shutdowns also incentivizes self-regulation in other ways as illustrated by the rules of Hydra. When the government does not attempt to shut down all existing darknet marketplaces, marketplaces that primarily earn revenue through drugs benefit from prohibiting “socially reprehensible” goods such as contract killings which would increase the attention of the police and the probability of shutdown.
4. **Large marketplaces can be utilized for harm-reduction interventions.** A centralized marketplace is a convenient place for outreach programs spreading awareness among drug consumers. For example, Davitadze et al. (2020) describes an effort by an NGO to provide information about HIV and HCV and advertise its harm reduction services on Hydra’s forum. Interestingly, Hydra collaborated with the NGO and promoted this information on its Telegram channel. Similarly, Bancroft, 2017 shows how a large marketplace can become a platform for drug consumers to share information about harm reduction.
5. **Online marketplaces can reduce violence.** At the moment, we have no quantitative evidence of the effect of Hydra on crime levels in Russia. However, prior research has shown that online marketplaces produce less violence than traditional street trade due to reduced face-to-face contact (see Aldridge et al., 2018, Aldridge and Décary-Héту, 2014). The scale of Hydra meant that it was able to facilitate supply-side transactions including recruitment and wholesale drug trade. Hence the benefit of reduced violence should have extended up the supply chain and thus the benefits of reduced violence were likely stronger than in a situation where only retail trade is digitalized.
6. **Online marketplaces increase the transparency of drug markets.** By its nature, the market for illicit drugs is extremely hard to observe for the government. An online marketplace can be scraped, and this data can be used for informing drug policy in the future. For example, this can help to track changes in the level of drug consumption in the country. It can also allow authorities to sooner observe dangerous trends such as consumers switching to more harmful substances, e.g., fentanyl.

Both the positive and negative effects of shutting growing darknet marketplaces down can be substantially amplified because large marketplaces are likely to benefit from economies of scale. In other words, large marketplaces have the tendency to grow extremely large because they become more efficient. First, a large marketplace

can invest more in the development and support of its website.<sup>18</sup> In Section 3.4 we show that the level of sophistication of a large marketplace like Hydra can become very high. Second, the popularity of the market might grow even more when it increases the number of listings available. Our interviewees specifically mentioned that Hydra was growing quickly in a particular city after dead-drops become available in all neighborhoods of the city and drug consumers learn that they can always find a listing in close proximity to them.

The example of Hydra shows new and important aspects of the trade-off faced by governments around the world in determining whether to pursue a policy of indiscriminately shutting down popular darknet marketplaces. In particular, we show that a large marketplace like Hydra can facilitate communication between drug producers and drug sellers, thereby increasing the supply of drugs. This phenomenon was less pronounced for Western darknet markets, which were smaller than Hydra. We also show the potential benefits of large darknet marketplaces that previously attracted little attention. Specifically, we show that Hydra had an efficient reputation system that could have positively affected the quality and related health outcomes, was able to shift even wholesale drug trade online thus potentially reducing much of the gang violence often associated with these transactions, and was self-regulating in several ways. More research is needed for the quantification of this crucial trade-off as well as consideration of other potential policy interventions such as the postal investigation policy in Russia which effectively restricted supply as shown above.

## 6 Conclusion

This paper provides a unique quantitative overview of Hydra, an illegal darknet marketplace which was dominant in Russia for several years prior to its closure. Using two novel datasets of scraped data including reviews and drug listings on Hydra, we provide estimates of drug buying behaviour online: the popularity of various drugs, their prices, volumes, and geographic distribution. We also provide evidence suggesting that until its closure in April 2022, the Hydra marketplace had been the dominant method to obtain drugs in Russia.

Possibly the main feature which distinguished Hydra from darknet marketplaces in other countries and accounted for its market dominance was its age. Following the shutdown of RAMP in 2017, Hydra was allowed to develop and establish its market position over many years until its eventual shutdown in 2022. In contrast, of the 83 western darknet marketplaces studied in Bhaskar et al. (2019), the original Silk Road was the longest surviving at 976 days of operation. This stability appears to have allowed Hydra to gain a market share far in excess of that achieved by darknet marketplaces in the West where the offline street trade still accounts for the vast majority of trade. This long lifespan also allowed Hydra to develop several complex mechanisms such as dispute resolution, advertisement auctions, reputation system, and harm reduction through telemedicine services despite being an illegal entity. Using cryptocurrency-based transactions, encrypted Tor-based messaging, and no physical contact between buyers, sellers, and couriers, Hydra became the largest online illegal marketplace for drugs so far. It serves as an example of the potential evolution of the online drug market if a given darknet market is allowed to grow unchecked for several years.

There are two major limitations of the listings data used in this paper. First, the dataset only covers April 2020, when COVID-19 lockdowns were first enacted in Russia. This likely affected both the demand and supply of drugs on Hydra, impacting the ability of couriers to hide drugs as well as the ability of consumers to collect dead-drops. Second, the short interval of time covered by the dataset prohibits us from analyzing the development of the marketplace. In future work, we hope to be able to access a longer panel dataset to allow for the analysis of the evolution of the Hydra marketplace over time.

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<sup>18</sup>These costs typically are higher for a darknet platform than for a “clearnet” platform. For example, software engineers must be compensated more for working on an illegal project, and hosting a darknet website is more expensive.

Finally, we believe that the case of Hydra illustrates that there are many sides of the trade-off that governments face when they make the policy choice to shut down darknet marketplaces. Quantification of this trade-off is important for addressing the problem of drug abuse. We hope that future research on illegal drug marketplaces will develop in this direction.

## References

- Aldridge, J., Décary-Hétu, D., 2014. Not an eBay for drugs: the cryptomarket Silk Road as a paradigm shifting criminal innovation. Available at SSRN 2436643 .
- Aldridge, J., Stevens, A., Barratt, M. J., 2018. Will growth in cryptomarket drug buying increase the harms of illicit drugs? *Addiction* 113, 789–796.
- Bancroft, A., 2017. Responsible use to responsible harm: illicit drug use and peer harm reduction in a darknet cryptomarket. *Health, Risk & Society* 19, 336–350.
- Bhaskar, V., Linacre, R., Machin, S., 2019. The economic functioning of online drugs markets. *Journal of Economic Behavior & Organization* 159, 426–441.
- Caulkins, J. P., Reuter, P., 1998. What price data tell us about drug markets. *Journal of Drug Issues* 28, 593–612.
- Červený, J., van Ours, J. C., 2019. Cannabis prices on the dark web. *European Economic Review* 120, 103306.
- CNBC, 2022. World’s biggest darknet marketplace, Russia-linked Hydra Market, seized and shut down, DOJ says. <https://www.cnn.com/2022/04/05/darknet-hydra-market-site-seized-and-shut-down-doj-says.html> [Accessed: June 28, 2022].
- Davitadze, A., Meylakhs, P., Lakhov, A., King, E. J., 2020. Harm reduction via online platforms for people who use drugs in Russia: a qualitative analysis of web outreach work. *Harm Reduction Journal* 17, 1–9.
- Décary-Hétu, D., Giommoni, L., 2017. Do police crackdowns disrupt drug cryptomarkets? a longitudinal analysis of the effects of operation onymous. *Crime, Law and Social Change* 67, 55–75.
- Demant, J., Munksgaard, R., Houborg, E., 2018. Personal use, social supply or redistribution? cryptomarket demand on silk road 2 and agora. *Trends in Organized Crime* 21, 42–61.
- Espinosa, R., 2019. Scamming and the reputation of drug dealers on darknet markets. *International Journal of Industrial Organization* 67, 102523.
- Foley, S., Karlsen, J. R., Putniņš, T. J., 2019. Sex, drugs, and bitcoin: How much illegal activity is financed through cryptocurrencies? *The Review of Financial Studies* 32, 1798–1853.
- Hardy, R. A., Norgaard, J. R., 2016. Reputation in the Internet black market: an empirical and theoretical analysis of the deep web. *Journal of Institutional Economics* 12, 515–539.
- Janetos, N., Tilly, J., 2017. Reputation dynamics in a market for illicit drugs. arXiv preprint arXiv:1703.01937 .



- Knife Media, 2020. Chto proishodit s rossiskoi narkotorgovlei iz-za koronavirusa? (What happens with Russian drug trade because of the Covid-19 pandemic?). <https://pandemic-research.github.io/coronavirus/> [Accessed: June 28, 2022].
- Lenta.ru, 2022. Proizoshla nastoyashchaya revolyutsiya. v Rossii proiskhodit peredel rynka narkotikov v darknete. chem eto grozit zhitelyam strany? (“A real revolution has happened”. the dark web drug market in russia goes through through a redistribution. what does this mean for the people? <https://lenta.ru/articles/2022/05/04/hydra/> [Accessed: October 17, 2022].
- Martin, J., Munksgaard, R., Coomber, R., Demant, J., Barratt, M. J., 2019. Selling Drugs on Darkweb Cryptomarkets: Differentiated Pathways, Risks and Rewards. *The British Journal of Criminology* 60, 559–578.
- Meduza, 2022. ‘If only we had the political will’. Why Russia’s rise in drug overdose deaths is unlikely to end soon. Accessed: October 17, 2022.
- Miller, J. N., 2020. The war on drugs 2.0: Darknet fentanyl’s rise and the effects of regulatory and law enforcement action. *Contemporary Economic Policy* 38, 246–257.
- Reuter, P., Greenfield, V. A., 2002. Measuring global drug markets: How good are the numbers and why should we care about them? Tech. rep., RAND Corporation.
- Saidashev, R., Meylakhs, A., 2021. A qualitative analysis of the Russian cryptomarket Hydra. *Kriminologisches Journal* 53, 169 – 185.
- Soska, K., Christin, N., 2015. Measuring the longitudinal evolution of the online anonymous marketplace ecosystem. In: *24th USENIX Security Symposium (USENIX Security 15)*, pp. 33–48.
- The Project, 2019. Vsyta eta dur. Issledovanie o tom, na chem sidit Rossiya (All those drugs. A study on narcotics that Russia is hooked on). Accessed: June 28, 2022.
- United Nations Office on Drugs and Crime, 2021. Global overview of drug demand and drug supply. <https://www.unodc.org/unodc/en/data-and-analysis/wdr-2021-booklet-2.html> [Accessed: June 28, 2022].
- United States of America V. Dmitry Olegovich Pavlov, 2022. United States District Court. <https://www.justice.gov/opa/press-release/file/1490906/download> [Accessed: June 28, 2022].
- Vlassov, V., Meilahs, P., Soshnikov, S., Idrisov, B., 2021. Illegal drug sales in the mirror of the dark web marketplace. *European Journal of Public Health* 31, ckab165–266.
- Zambiasi, D., 2022. Drugs on the web, crime in the streets. the impact of shutdowns of dark net marketplaces on street crime. *Journal of Economic Behavior & Organization* 202, 274–306.
- Zheluk, A., Quinn, C., Meylakhs, P., et al., 2014. Internet search and krokodil in the Russian Federation: an infoveillance study. *Journal of medical Internet research* 16, e3203.
- Zvonka, G., 2017. Sbor i analiz dannyh s rossijskih anonimnyh torgovyh ploshchadok (Data collection and analysis from Russian anonymous marketplaces). Student thesis, Higher School of Economics, <https://www.hse.ru/en/edu/vkr/206742486> [Accessed: September 17, 2022].