9^{th} International Conference on Computational Social Science IC^2S^2
July 17-20, 2023, Copenhagen, Denmark

Interventions and Illegal Drug Use: Evidence from a Darknet Marketplace

Keywords: illicit drugs, public health, dark web marketplaces, demand estimation, crime

Extended Abstract

Introduction. Supply-side drug enforcement is the main policy that governments use to reduce illegal drug use. However, while actions such as seizures may decrease consumption of the drug seized, if different types of illegal drugs are substitutes, economic theory would suggest these actions also encourage the consumption of other drugs. This raises the question: what are the consequences of drug reduction policies given potential substitutions between drugs?

A similar question relates to increases in supply that governments failed to prevent, in particular, the recent introduction of new synthetic drugs. While many of these drugs have achieved large market shares, calculation of the welfare costs of their introduction must consider the offsetting impact of potential substitution towards them from traditional drug types.

To answer these questions, we use a novel micro-level dataset scraped from Hydra, a Darknet marketplace which covered the majority of the retail illegal drug trade in Russia for several years. From this data we estimate a model of the demand and supply of illegal drugs to evaluate the effects of various supply-side interventions such as seizures of different drugs.

Contribution. The first related strand of literature is the estimation of demand for illicit drugs. Our contribution to it is threefold. First, our dataset allows us to estimate the consumption of illegal drugs without relying on proxy measures like emergency department visits (Dave, 2006) or traffic fatalities (Anderson et al., 2013). Second, we are the first to apply the BLP approach, which is the standard in the modern demand estimation literature, in the context of illicit drugs. Third, our dataset allows us to observe sales of different drug types at the same time and estimate cross-price elasticities of substitution for a large set of popular drugs.

Our paper also contributes to the literature on the effects of supply-side interventions. Becker et al. (2006) provides a theory that highlights the key role of own price elasticities in determining these effects. In addition, substitution patterns are extremely important to quantify the welfare impacts of interventions. For example, Alpert et al. (2018) finds that mortality has increased as some of consumers addicted to Oxycontin switched to heroin after a supply-side intervention. As our model allows for the full set of substitutions between drugs types it allows us to estimate the equilibrium net welfare impacts of interventions.

Data. We are using data scraped from the Hydra marketplace because it allows to observe a large proportion of the trade of illegal drugs in a particular region. There are two specific advantages of our dataset that allow us to estimate the amount of drugs sold in different regions. First, Hydra was the largest darknet marketplace in the world and spanned the majority of the drug trade in the largest Russian cities.[1] Second, Hydra utilized a unique distribution system,

[1]US Department of Justice has obtained an indictment against the alleged administrator of Hydra servers (United States of America V. Dmitry Olegovich Pavlov, 2022). According to the document, Hydra accounted for 80% of all darknet market cryptocurrency transactions in 2021 and more than $5 billion in transactions since 2016. In 2019, more than 2.5 million accounts were already registered on Hydra.

relying on pre-hidden drug stashes instead of sending drugs over mail. As vendors listed information about all stashes on the website, the scraped data on listings allows us to estimate total quantities sold in each location where the market has operated.

We use data on listings for 38 days from June 2019 to September 2020. We observe more than 6 million listings, across 40 different drug types and 1,337 different cities or towns. In addition to this, we have data on a sub-sample of consumer reviews, a total of 465,309 reviews.

Estimation. Using data scraped from the marketplace, we calculate market shares and average prices and apply the BLP method (Berry et al., 1995) for estimating demand. Specifically, we estimate the discrete choice model in which a consumer i receives indirect utility from buying a particular drug j in city c in period t:

$$U_{ijct} = x_j\beta_i - \alpha_i p_{jct} + \xi_{jct} + \varepsilon_{ijct}.$$

Here, j is at the drug type, size, delivery method, and quality level (e.g., 1 gram of medium quality cocaine hidden in a park). Product characteristics x_j include variables like drug category, quality, and hiding mode and ξ_{jct} are unobserved product characteristics. Importantly, α_i and β_i are consumer-specific coefficients that vary by demographics. This allows us to account for heterogeneity of preferences widely discussed in studies on addiction: younger people may consume more drugs, people with lower income may be more sensitive to price changes, etc.

Findings. The introduction of new synthetic drugs also known as "bath salts" (e.g., mephedrone and α-PVP) was a major change in the market for illegal drugs in many countries. We estimate that the introduction of bath salts has increased demand for drugs by 54%. This highlights the importance of accounting for substitutions between drugs: as roughly a half of all drugs sold are bath salts, ignoring substitution from other drug types would suggest their introduction had a substantially larger effect of $\approx 110\%$.

As the next step, we are working on modelling the supply of illicit drugs. After that, we will estimate the effects of the most common supply-side interventions used by governments.

References

Dave, D. The effects of cocaine and heroin price on drug-related emergency department visits. *Journal of Health Economics* **2006**, *25*, 311–333.

Anderson, M.; Hansen, B.; Rees, D. I. Medical marijuana laws, traffic fatalities, and alcohol consumption. *The Journal of Law and Economics* **2013**, *56*, 333–369.

Becker, G. S.; Murphy, K. M.; Grossman, M. The market for illegal goods: the case of drugs. *Journal of Political Economy* **2006**, *114*, 38–60.

Alpert, A.; Powell, D.; Pacula, R. L. Supply-side drug policy in the presence of substitutes: Evidence from the introduction of abuse-deterrent opioids. *American Economic Journal: Economic Policy* **2018**, *10*, 1–35.

United States of America V. Dmitry Olegovich Pavlov, United States District Court. 2022; `https://www.justice.gov/opa/press-release/file/1490906/download`.

Berry, S.; Levinsohn, J.; Pakes, A. Automobile prices in market equilibrium. *Econometrica: Journal of the Econometric Society* **1995**, 841–890.