

WE KNOW WHERE YOU ARE, WHAT YOU ARE DOING AND WE WILL CATCH YOU

Testing Deterrence Theory in Digital Drug Markets

ISAK LADEGAARD*

Is crime reduced by highly publicized punishment events? Is crime reduced by law enforcement's public relations work? These longstanding questions are addressed in a novel context—digital drug markets. An analysis of trade data from two large and illegal e-commerce websites, collected on a daily basis for ten months, examined how market revenue was affected by (1) media coverage of police work on such markets and (2) the highly publicized conviction and life-sentencing of a market founder. Trade increased after periods with elevated media coverage, and also after the two court events. Possible explanations for the increase in trade after the trial outcomes are discussed in an analysis of textual conversations in three online forums associated with illegal e-commerce.

Keywords: deterrence, cybercrime, mass media, punishment, drug trade, illegal markets, cryptomarkets

Introduction

Silk Road, an e-commerce website for banned goods and services, opened for business in January 2011. Access was only possible through the anonymization software The Onion Router (Tor), which obstructs the tracking of IP addresses, and all payments were done in Bitcoin, a digital currency (Barratt 2012) that can be laundered, and moved around online without going through banks (Meiklejohn *et al.* 2013). E-commerce markets like Silk Road, henceforth called cryptomarkets (Martin 2014a), primarily facilitate drug trade between individual customers and vendors (Barratt and Aldridge 2016). Silk Road's 'staff' advertised itself thusly:

The Silk Road is an anonymous online market. Current offerings include Marijuana, Hash, Shrooms, LSD, Ecstasy, DMT, Mescaline, and more. The site uses the Tor anonymity network, which anonymizes all traffic to and from the site, so no one can find out who you are or who runs Silk Road. For money, we use Bitcoin, an anonymous digital currency (2011).

The popular press first wrote about the Silk Road in June 2011, half a year after its launch (Chen 2011). Rather than hiding from the limelight, the market's administrator, who used the pseudonym 'Dread Pirate Roberts' (DPR), responded to inquiries from journalists and even did a full profile interview for Forbes Magazine (Greenberg 2013) that he later promoted on the social media website Twitter. The Federal Bureau of Investigation (FBI) seized Silk Road's servers and arrested DPR in October 2013, but a few weeks afterwards, a team consisting of former Silk Road staffers promoted a newly created Silk Road 2 (Décary-Hétu and Giommoni 2016).

*Isak Ladegaard, Department of Sociology, Boston College, 140 Commonwealth Avenue, Chestnut Hill, MA 02467-3807, USA; isak.ladegaard@bc.edu.

The bounce-back received wide media coverage. [Reuters \(2013\)](#), for example, wrote: ‘New Silk Road drug bazaar opens a month after FBI bust’. Journalists emphasized the seeming continuity of the Silk Road brand—a central Silk Road 2 figure even adopted the DPR username, and the ‘new’ DPR was, like the old, communicative with reporters and had a vocal social media presence. On 7 November 2013, for example, he wrote on Twitter: ‘We’re at over 20,000 registrants already. Amazing show for #freedom #silkroad and #theidea’ ([Dread Pirate Roberts 2013](#)). In November 2014, however, the FBI and Europol closed the second Silk Road website and arrested the new DPR ([U.S. v. Ulbricht 2015](#)). Law enforcement framed both Silk Road operations as major achievements—US Attorney Preet Bharara, for example, stated in a press release that ‘criminals can no longer ... hide in the shadows of the dark web’ ([US Department of Justice 2013](#)), while a top official in the National Crime Agency (NCA) said: ‘The hidden internet isn’t hidden and your anonymous activity isn’t anonymous. We know where you are, what you are doing and we will catch you’ ([NCA 2013](#)). Law enforcement also communicated their advances directly to cryptomarket users, by replacing the home page of the two Silk Roads with agency logos.

Much research has sought to test the theory of criminal deterrence and its underlying assumption that lawbreakers are rational beings who do what is pleasurable or beneficial, and avoid acts that are painful and/or costly ([Zimring and Hawkins 1973](#); [Gibbs 1975](#)). If Jane Doe intends to break the law to achieve a particular goal, but comes to believe that she will be detected or harshly punished, she might reconsider. It logically follows that if the perceived likelihood of detection has increased or if the punishment that might await her has become more severe, she is less likely to break the law, and in aggregate, crime rates will drop. Mixed research findings suggest that the deterrent effect of severe punishment is weak ([Mocan and Gittings 2001](#); [Dezhbakhsh *et al.* 2003](#); [Berk 2005](#); [Dezhbakhsh and Shepherd 2006](#); [Donohue and Wolfers 2006](#); [Fagan 2006](#); [Nagin 2013a, 2013b](#)), in part because the relationship between objective and subjective sanction threats is also weak ([Piliavin *et al.* 1986](#); [Horney and Marshall 1992](#); [Kleck *et al.* 2005](#); [Lochner 2007](#)). A key challenge in the criminal justice system is therefore to install a sense of increased risk of punishment in the individual that is contemplating criminal behaviour ([Nagin 1998, 2013a, 2013b](#)).

One example of such efforts is law enforcement’s public relations work, e.g. when the US Attorney tweeted ‘Silk Road = Road to prison’ ([FBI New York 2014](#); [US District Court, Southern District of New York 2014](#)). The message, and others like it, appears to be drawing on the social logic of criminal deterrence. Another example is the punishment of the Silk Road founder. When Judge Forrest read her sentencing statement in the court ([U.S. v. Ulbricht 2015](#)), she said:

Defense counsel has argued that general deterrence, through sentencing, is illusory. I listened very closely. I have read very, very closely the articles and interestingly, in a study cited by defense counsel – which is Kleck as the lead author – the author acknowledges, right towards the back of the article, ‘It is also possible that unusually highly publicized punishment events may generate deterrent effects that the routine, largely unpublicized punitive activities of the criminal justice system ordinarily do not.’ (p. 86)

With this study I am able to test if media coverage of law enforcement’s ability to apprehend cryptomarket users deters trade, and if the ‘highly publicized punishment’ of the Silk Road founder, Ross Ulbricht, did in fact reduce the activities that he was sanctioned for facilitating.

Two hypotheses are tested:

1. Media coverage of advances in law enforcement will reduce crime.
2. A highly publicized conviction and sentencing of a key actor in an illegal market will reduce trade in similar markets.

Newspaper articles were collected from the digital archive Factiva. Trade data were collected directly from two large cryptomarkets, on a daily basis for more than ten months. To discuss changes in trade patterns after the trial outcome, the analysis also draws on data from three discussion forums associated with cryptomarkets.

Cybercrime and Expert Systems

A full review of the literature on cybercrime (see [Wall 2007](#)) is beyond the scope of this study, but it is important to briefly discuss some of the characteristics of computer-mediated communication as they might have implications for the social logic of crime and deterrence. Computer-mediated communication is undoubtedly ‘real’ in the symbolic interactionist sense, as the consequences of the communication are experienced as real to the people involved ([Chayko 2008](#)), but face-to-face interaction is of a different experiential quality than cyber encounters. Social dilemma games, for example, have found that face-to-face communication situations are significant improvements over text chat in establishing trust ([Bos et al. 2002](#)). Social context and media also shape how people spend and attach meaning to money ([Zelizer 1997](#)), so the meaning of digital trade might be shaped by the dominant currency, Bitcoin, which is unregulated, decentralized and lauded by cyber libertarians ([Bohr and Bashir 2014](#)).

Cryptomarket trade also requires that users have faith in particular ‘expert systems’. That is, customers and vendors not only need to establish trust in the good intentions of their exchange partners, which is a major challenge in all illegal markets ([Beckert and Wehinger 2012](#)), they also have to have faith in technological design that they are unlikely to fully understand ([Giddens 1996](#): 33–4). Much like how people accept that driving is a dangerous activity but nonetheless drive to work in the morning because they trust the expertise behind the construction of vehicles, highways and traffic lights ([Giddens 1991](#)), cryptomarket actors demonstrate their explicit or implicit trust in the anonymizing software (e.g. Tor) and cryptocurrencies (e.g. Bitcoin) that they use to trade banned goods and services ([Barratt 2012](#); [Christin 2013](#); [Martin 2014a, 2014b](#)). Cybercrime often involves cracking digital expert systems, e.g. hacking ([Jordan and Taylor 1998](#)), but in this case, it is law enforcement that is trying to expert systems that market actors depend upon. Customers and vendors might be more or less oblivious to this threat, as long as the web pages load and money transfers work, and it is possible that they are therefore undeterred by law enforcement’s advances. It is also possible that they are moving with acute caution. If either of these individual-level behaviours are salient in aggregate, one might expect to find measurable deterrent effects (or lack thereof) of news reports that shake up their trust in cryptomarkets, and also the trial outcome, which suggests that expert systems failed to protect cryptomarket users.

Trade in cryptomarkets

Cryptomarkets connect thousands of vendors to many more customers all across the world ([Christin 2013](#); [Aldridge and Décary-Hétu 2014](#); [Soska and Christin 2015](#);

Décary-Hétu *et al.* 2016; Décary-Hétu and Giommoni 2016; Demant and Houborg 2016; Van Buskirk *et al.* 2016a), and actors utilize this newfound agency by conducting a range of illicit activities that may not be possible through conventional, interpersonal trade networks (Martin 2014b; Barratt *et al.* 2016), e.g. buying rare psychostimulants (Van Buskirk *et al.* 2016b).

Cryptomarket trade is facilitated by sophisticated market mechanisms. A customer in Brussels and a vendor in Stockholm could be negotiating an economic exchange from their respective living-room armchairs. The customer has probably looked through the vendor's feedbacks and might have chosen to buy from the Belgian because she offers escrow payment, i.e. the payment will be temporarily stored in the market website until the order has been received (Van Hout and Bingham 2013a; 2013b; Aldridge and Décary-Hétu 2014; Martin 2014b; Van Hout and Bingham 2014; Aldridge and Décary-Hétu 2016b; Hardy and Norgaard 2016; Holt *et al.* 2016; Tzanetakis *et al.* 2016). Before placing the order, the customer could read up on security practices and harm reduction advice in related discussion forums (Barratt *et al.* 2013; Van Hout and Bingham 2013a; 2013b; Martin 2014b; Van Hout and Bingham 2014). The sophisticated features of cryptomarkets might function as a filter: many actors are highly proficient users of information technology (Van Hout and Bingham 2013b; Bancroft and Reid 2015; Kruithof *et al.* 2016), and vendors are advantaged by having good customer service skills, well-written profiles and good reputations via feedback (Hardy and Norgaard 2016; Tzanetakis *et al.* 2016) rather than having access to 'muscle' (Aldridge and Décary-Hétu 2014).

One central reason to expect some measure of deterrence in cryptomarkets is that most qualitative research portray their users as rational economic actors (for two exceptions, see Maddox *et al.* 2016; Munksgaard and Demant 2016). Vendors are described as having a professional approach to their businesses (Van Hout and Bingham 2013a) and consumer choices in cryptomarkets are primarily based on perceived product quality and vendor reputation (Van Hout and Bingham 2013b, 2014). The trade appears to be unabated by law enforcement crackdowns as closed markets are replaced by new ones (Soska and Christin 2015; Décary-Hétu and Giommoni 2016; Van Buskirk *et al.* 2016a), but that does not mean that actors are incautious. Vendors and customers might prefer domestic exchange to reduce the additional risk that is incurred by cross-border shipments (Décary-Hétu *et al.* 2016; Van Buskirk *et al.* 2016a), and people who continue to use cryptomarkets after law enforcement operations report that they do so with less confidence (Barratt *et al.* 2016b). Moreover, some study participants who have heard of markets like Silk Road opt not to use them because they already have adequate access to drugs in their personal networks, or because they fear being caught (Barratt *et al.* 2016a).

Deterrence Theory

One unsettled question in crime research is the extent to which punishment deters crime (Currie 1985). At the centre of this debate is the notion that people rationally strive to avoid unpleasant consequences, such as punishment (Zimring and Hawkins 1973; Gibbs 1975). The premise of the contemporary definition of deterrence is similar, but the emphasis is on people's response to their *perception* of sanction threats. That is, the objective likelihood of punishment will not necessarily deter lawbreaking, because what really matters is the subjective sense of risk (Nagin 2013a, 2013b; Kleck and Barnes 2014).

Studies that present participants with hypothetical scenarios, and survey or interview would-be criminals, have found support for deterrence theory across populations and countries (e.g. Teevan 1976; Klepper and Nagin 1989; Grasmick and Bursik 1990; Bachman *et al.* 1992; Decker *et al.* 1993; Paternoster and Simpson 1996; Apel 2013; Hirtenlehner *et al.* 2013), but relatively little is known about how objective increases in risk affect perceptions of risk (Paternoster 2010), besides that people generally do a poor job in connecting the two (Kleck *et al.* 2005; Lochner 2007; Kleck and Barnes 2014), and crucially, that risk perceptions are malleable (Bachman *et al.* 1992; Paternoster and Simpson 1996; Apel 2013). Active drug dealers, for example, gossip about arrests and people in their circuits behaving ‘sketchy’, and such information influence behaviour if the source is trusted (Dickinson and Wright 2015). Drawing on this literature, I expect to find a measurable decrease in cryptomarket trade after media reports on law enforcement’s advancement in their efforts to stop such trade. Media consumption is known to affect people’s perception of risk (Pfeiffer *et al.* 2005), and coverage of apprehension of customers and vendors, and multinational collaboration between law enforcement agencies, might affect an actor’s perceived certainty of punishment.

The sentencing of Ulbricht reflects severity, that is, the deterrent effect of severe punishment. Scholars have argued that the deterrent effects of severe punishment can be strong—in some studies, even a single execution produced a statistically significant reduction in homicide rates (Mocan and Gittings 2001; Dezhbakhsh *et al.* 2003; Dezhbakhsh and Shepherd 2006). However, replication studies have found that minor changes in the applied statistical models yielded different results and contrary conclusions (Berk 2005; Donohue and Wolfers 2006; Fagan 2006). Detailed reviews of the literature conclude that due to mixed findings, there is insufficient evidence to claim that severe punishment deters crime (Nagin 1998; Paternoster 2010; Nagin 2013*a*, 2013*b*). Drawing on this scholarship, I expect to find no measurable decrease in cryptomarket trade following the sentencing of Silk Road’s creator, who faced a minimum of 20 years in prison, but was sentenced to ‘the severest possible penalty to be imposed’, life without parole (U.S. v. Ulbricht 2015: 95).

Methods

Trade estimation

The two cryptomarkets studied—Evolution and Agora—required customers to leave feedback for every purchase they made (Soska and Christin 2015). To estimate trade in these markets, I therefore downloaded the web pages for all available items, and used customer feedbacks on those pages as proxies for trade of that item (Christin 2013; Aldridge and Décary-Héту 2014; Décary-Héту and Aldridge 2015; Soska and Christin 2015; Aldridge and Décary-Héту 2016*a*). This trade measure is the dependent variable for the major analyses in the paper. Specifically, I first wrote web crawlers in the programming language Python that downloaded all item pages from the two cryptomarkets. From 4 November 2014, the crawlers were executed every morning, with manual checks at least once per day. Data from Agora were collected for ten months, whereas data collection from Evolution was halted after about 4.5 months, when the market shut down unexpectedly, on 18 March 2015.

Next, I created programs that extracted relevant data from the downloaded web pages. After removing duplicates and data on trade prior to 4 November 2014, the datasets for Evolution and Agora contained information on 313,021 and 481,137 trades. Because

Evolution shut down during the data collection period, I focused the analyses of media coverage’s impact on trade on the period 4 November 2014–17 March 2015, for which I had daily data from both markets. The ‘intervention’ analysis of the conviction of Ulbricht, which fell on 4 February 2015, also included data from both markets. The sentencing of the same man fell on 29 May 2015, and the analysis of that event drew on Agora data only.

Media articles

Media reports on cryptomarket arrests and related law enforcement efforts were collected through the newspaper database Factiva. I searched the database for all articles written in English from relevant regions (Figure 2) that included at least one of several terms that I have seen referring to cryptomarkets in journalistic and academic sources, as well as in ‘indigenous’ sources, e.g. cryptomarket forums that I am familiar with from past research. Examples of such terms include Darknet, Dark Net, Deep Web, Cryptomarket, Silk Road, Tor, The Onion Router, DPR. When appropriate, I used wildcards (e.g. I searched for cryptomarket*, to include plural and singular versions of the keyword). An extensive manual cleaning of the data (e.g. removal of articles about referencing ‘Silk Road’ as the ancient network of trade routes) reduced the tally of



FIG. 1 Cryptomarket actors and law enforcement are engaged in a competing narrative about crime control. On the left, a message from FBI, posted on Silk Road 1’s URL address. In the middle, the response from the newly launched Silk Road 2. On the right, another message from law enforcement, after the shutdown of Silk Road 2

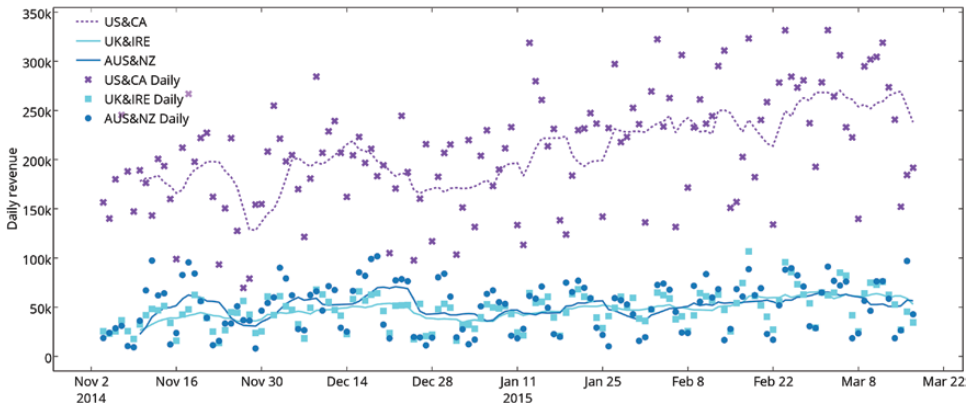


FIG. 2 Total vendor revenue (lines = seven-day mean) per region. Data from Evolution and Agora

articles from more than 1,000 to 310. I next counted the number of published articles per day for the period. As the intention was to test the lagged effect of media coverage on vendor revenue, the unit of measurement for trade was daily trade, while for media coverage, the unit was the mean number of articles published during the same day plus the six previous days.

Autoregressive integrated moving average

ARIMA models forecast equally spaced univariate time series data as a linear combination of past values and errors. The method is considered relatively powerful for assessing interventions (Cook *et al.* 1979) and has been used to measure a wide range of topics, including public confidence in the police (Sindall *et al.* 2012) policy impacts on substance abuse (Cunningham and Liu 2003; Koski *et al.* 2007; Cunningham *et al.* 2008). The method examines time series data for seasonal and trend patterns and adjust them if necessary, as it indeed was in this study. Trade volume and media coverage data were substantially reduced on Sundays—possibly because there are fewer journalists at work, while cryptomarket customers are more likely to place their orders earlier in the week, so that the products arrive in time of the beginning of the weekend. Analyses of sewages in 19 European cities have similarly suggested that illicit drug use spikes on Fridays and Saturdays (and early Sunday morning) (Thomas *et al.* 2012). Trade data also had a trend component as it was increasing throughout the data collection period. Thus, trade data were adjusted for both seasonality and trend, whereas media data were adjusted for seasonality only. The trade data also had irregularities due to the inherent instability of the markets. To control for market instability, I used data from DNStats.net, which tested the downtime status of each market 288 times a day, throughout the data collection period. I calculated the daily mean of these data and included them in the ARIMA models.

I used the `auto.arima` package in R, which minimizes the AICc values to obtain the most appropriate ARIMA model (Hyndman and Khandakar 2008; Hyndman and Athanasopoulos 2014). The suggested models were subsequently checked for residual autocorrelation. In simple terms, residual correlation means that the ARIMA model can be improved. All models passed their respective Ljung–Box tests, which indicate that the used models were appropriate for the data.

To measure how trade was affected by (1) the guilty verdict in *U.S. v. Ulbricht* on 4 February 2015 and (2) the subsequent life-sentencing of the same man, on 29 May 2015, I created dummy variables for the periods before ('0') and after ('1') the guilty verdict, and before ('0') and after ('1') the life-sentencing. I then estimated whether trade continued as forecasted, based on observations from the pre-event periods. To create a visually intuitive measure of the effect of the life-sentence on trade, I created charts in which forecasted trade figures are compared with actual observations (McDowall 1980; Vasquez *et al.* 2008; Dugan 2010).

Findings

Media coverage and vendor revenue

Data on media coverage and vendor revenue were separated into three regional categories: Australia and New Zealand; the United Kingdom and Ireland and Canada and

the United States. Data on vendor revenue in other regions were excluded from this particular analysis. The rationale for the region-specific focus is that news reports from one region might not be widely read in other regions, and/or the reports will be seen as irrelevant to vendors and customers in other locations. For example, customers and vendors in the United Kingdom and Ireland might not be concerned by a news article with this headline: ‘A Washington State man ... has been charged with conspiracy to distribute drugs on Silk Road 2’ ([The Star 2015](#)). The same article contains a statement from a US attorney which highlights regional intelligence operations: ‘The arrest ... is proof that federal law enforcement continues its efforts to root out those who subvert the Internet to set up black markets for illegal goods’. However, the article also contains a statement from a special agent of Homeland Security Investigations that might be of some concern for cryptomarket actors outside of the United States: ‘The co-ordinated efforts of U.S. and international law enforcement agencies to disrupt anonymous black market websites continues to pay off’. This is typical for media reports in the sample—domestic cases often include language that highlights multinational law enforcement cooperation, and it is possible that at least some reports in American media would deter action in other regions. I therefore created a fourth category in which I combined media article counts and vendor revenue figures in the six English-speaking regions.

In some cases, a news report was difficult to place in a single category. A piece by the [Australian Associated Press \(2015\)](#) serves as an example: ‘Former Queensland prison employee jailed in New York for allegedly being a key member of the Silk Road online criminal marketplace is negotiating a potential plea deal with US prosecutors’. This article, and others like it, was included in the US and Canada region *and* the Australia and New Zealand region.

ARIMA models show that trade in the three respective regions, and the combined-region category, increased significantly after a seven-day period with above-average frequency of media coverage of cryptomarket-specific issues.

United States v. Ulbricht

The verdict in the court case against the Silk Road 1 founder was a potential turning point for his supporters, in large part because the defense had argued that the cryptomarket reduced harm:

In contrast to the government’s portrayal of the Silk Road web site as a more dangerous version of a traditional drug marketplace, in fact the Silk Road web site was in many respects the most responsible such marketplace in history ... transactions on the Silk Road web site were significantly safer than traditional illegal drug purchases, and included quality control and accountability features that made purchasers substantially safer than they were when purchasing drugs in a conventional manner. ([U.S. v. Ulbricht 2015](#))

Ulbricht’s defense added that discussions in Silk Road’s forum covered health concerns, and even included a thread with expert advice from a licensed MD, who was paid a salary ([U.S. v. Ulbricht 2015](#)). The jury was not swayed by the argument, and on 4 February 2015, they found Ulbricht guilty on seven counts related to his oversight of Silk Road 1, including distribution of narcotics, which carries a potential life-sentence. ARIMA models show that trade increased after the conviction ([Table 1](#)).

Nearly four months later, on 29 May 2015, Ulbricht was sentenced to the maximum punishment available—life in prison without parole. In her statement, the Judge referred to a paper by Kleck *et al.* (2005) that critiques deterrence theory while also acknowledging that ‘unusually highly publicized punishment events may generate deterrent effects that the routine, largely unpublicized punitive activities of the criminal justice system ordinarily do not’ (p. 654). The Judge further noted that she was handling a case without serious precedent, and that the defendant would therefore have to ‘bear the general deterrence’:

In breaking that ground ... you sit here as the defendant now today having to pay the consequences for that. ... For those considering stepping into your shoes, carrying some flag, some misguided flag, or doing something similar, they need to understand very clearly and without equivocation that if you break the law this way there will be very, very severe consequences. ... There must be no doubt that you cannot run a massive criminal enterprise and, because it occurred over the Internet, minimize the crime committed on that basis (U.S. v. Ulbricht 2015: 87).

I find that trade in Agora increased significantly after the sentence (Table 2), for both US vendors and non-US vendors (Figures 3 and 4). Notably, US vendor revenue increased less than vendor revenue in other regions, but the difference is marginal (Figure 5).

TABLE 1 *Lagged media effects on vendor revenue*

	Model 1—all regions		Model 2—USA and Canada		Model 3—United Kingdom and Ireland		Model 4—Australia and New Zealand	
ARIMA	(1,1,1) (2,0,0) [7]		(1,1,1) (2,0,0) [7]		(1,1,1) (2,0,0) [7]		(1,0,0) (2,0,0) [7]	
Parameter	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Media	4251.18*	4405.46	1966.35*	4195.28	878.07*	996.21	2571.63*	1882.15
Error	-299579.7*	158449.5	-100561.7*	113816.4	-51836.01*	25967.67	-86096.2*	39155.67
Box–Ljung (lag 14):	$\chi^2 = 14.41$	$p = 0.42$	$\chi^2 = 9.62$	$p = 0.79$	$\chi^2 = 13.78$	$p = 0.47$	$\chi^2 = 10.63$	$p = 0.72$

ARIMA, autoregressive integrated moving average; Box–Ljung, Box–Ljung *Q*-test for residual autocorrelation. * < 0.01.

TABLE 2 *Guilty verdict and life-sentencing in U.S. v. Ross Ulbricht—effect on vendor revenue*

	Model 5—guilty not-United States		Model 6—guilty-United States		Model 7—life not-United States		Model 8—life-United States	
ARIMA	(2,0,0) (2,0,0) [7]		(0,1,1) (0,0,1) [7]		(3,1,4) (1,0,1) [7]		(1,1,2) (1,0,1) [7]	
Parameter	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Life	-	-	-	-	1928.85*	3252.53	71.70*	-57234.73
Guilty	9013.39*	6050.22	580.11*	2298.93	-	-	-	-
Error	-117031.98*	25904.88	-93932.88*	18504.44	-116041.89*	17569.46	-57234.73*	7124.89
Box–Ljung (lag 14):	$\chi^2 = 11.56$	$p = 0.64$	$\chi^2 = 7.72$	$p = 0.90$	$\chi^2 = 11.50$	$p = 0.65$	$\chi^2 = 7.47$	$p = 0.92$

ARIMA, autoregressive integrated moving average; Box–Ljung, Box–Ljung *Q*-test for residual autocorrelation. * < 0.01.

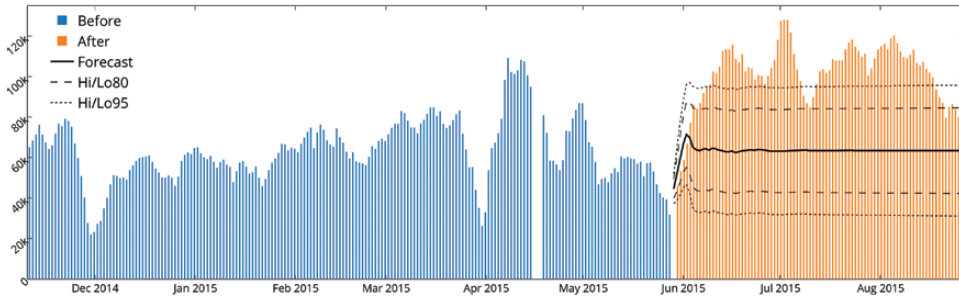


FIG. 3 Revenue for vendors who ship from the US, before and after the sentencing of Ulbricht. The prediction interval estimates where future observations will fall, with a .95 or .80 probability, based on previous observations

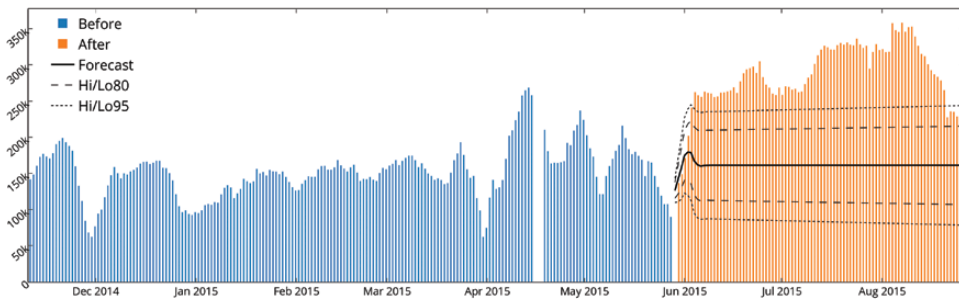


FIG. 4 Revenue for vendors who ship from any non-US location, before and after the sentencing of Ulbricht

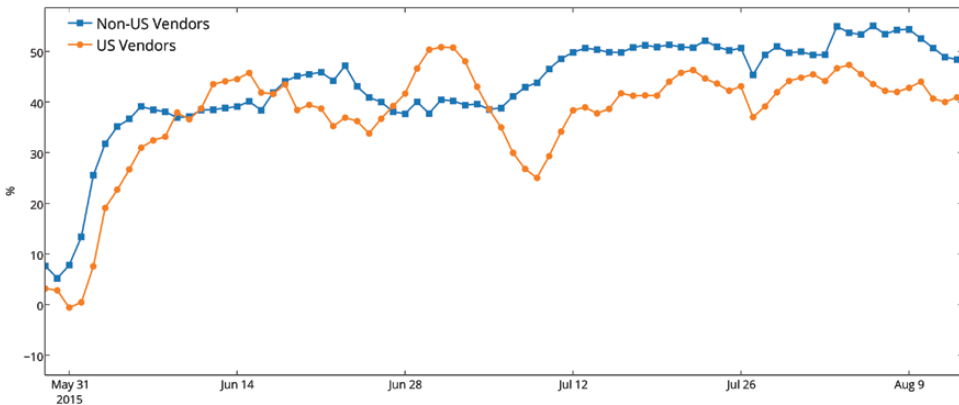


FIG. 5 Percent difference between forecasted trade revenue and actual trade revenue for vendors, after the sentencing of Ulbricht

The findings presented thus far suggest a positive relationship between media report frequency and market trade, and that trade increased after the guilty verdict and subsequent sentencing of Ulbricht. It must be noted, however, that these patterns might be caused by unknown external factors. For example, it is possible that media coverage of the trial attracted new customers and vendors, who otherwise would not have known that cryptomarkets existed, but that the number of new registrants would have been

much larger if Silk Road's founder had been acquitted. It is also possible that many existing customers and vendors were deterred from continuing in the markets, but that a surge in new users replaced them, and eventually lifted trade to new peaks. The difficulty of establishing causality is an important weakness in studies that relies upon naturalistic data collection—it is not possible control for all confounding variables when information about the subject matter is incomplete. However, the data that this article draws upon are of high validity and reliability, and the findings are robust enough to warrant further interpretation and discussion.

Community Response

To explore how market actors responded to the trial and its outcome, I read, coded and analysed conversations and statements in three discussion forums for cryptomarket users. Two of them were managed by Agora and Evolution, and the third, the Hub, is market-independent (and is still online, as of 2017). While actors who participate in forum conversations are not necessarily representative of the much larger population of cryptomarket vendors and customers, they make up a substantially sized group of such actors. The count of active members in the three forums, where active is defined as having posted at least once, were 5,668 in the Hub (2016), 20,839 in Evolution and 17,025 in Agora. To explore how the trial affected these market actors, and possible explanations for the trade increase, I created a subset of all discussion threads and posts from 14 January 2015, the first day of the Ulbricht trial, up until 29 June 2015—one month after the life-sentence. In the case of Evolution, the discussions ended on 18 March 2015, when the market and forum were taken offline. Next, I narrowed down the data by excluding threads that did not contain at least one relevant keyword, such as Ulbricht, life, sentence, convicted and trial. I then manually removed threads that were irrelevant to the topic. The final set of data contained 1,071 individual posts.

After one initial read-through, during which I took notes and jotted down potential codes, I re-read the same pages line-by-line and systematically coded them. At this point I was looking for the specific, e.g. the code 'advocating economic liberty' was used when forum users argued that the law enforcement operations were unjust because people should be able to buy the goods and services that they desire. In the subsequent round of coding, I was looking for the general and abstracted previous notes and codes so that the findings could be connected to theory, e.g. 'appeals to higher loyalties'. Quotes are presented in their original form, and all authors have been given pseudonyms.

A legend

Forum posters say that Ulbricht's work was pioneering. Shannon, for example, wrote in the Evolution forum that 'the website and forum you're posting on is indebted to his efforts in establishing free markets for all'. When Ulbricht presented a letter to Judge Forrest after being convicted, in which he said that he 'deeply regretted' his work and asked for the 20-year minimum ([U.S. v. Ulbricht 2015](#), Exhibit 1: 1–2), he was, Hub member Pandora said, forced to abandon his personal beliefs. 'To me, this is reminiscent of Galileo being forced to recant his assertions about earth's orbit in order to avoid being boiled alive or whatever the Vatican had planned for him'. Pandora next quoted Galileo's 17th century

abjuration: 'I must altogether abandon the false opinion that the sun is the centre of the world and immovable, and that the earth is not the centre of the world'. Cynic agreed that the 17th century scientist is an apt comparison. '[Ulbricht] opened up new frontiers. Boldly went where no man had been before. We would not be here if it were not for him'. Anonjon was of a similar sentiment. 'I think of him as a pioneer ... He was really running an experiment'. Slingshot, in Evolution, compared Ulbricht to another historical figure: 'Christopher Columbus discovered America [and] yet he died broke, and virtually forgotten ... [Ulbricht] may have done something groundbreaking, and revolutionary and I will give him credit for that'. 1990, another forum user, said that Ulbricht's name will live on. 'What a legend, in the next 1, 2, 10 years, there will be many Darknet markets, many will be forgotten [but] Silkroad and Dread Pirate Roberts will live in history forever'.

Ulbricht's efforts are also viewed as harm reducing. In a Hub thread titled 'Pray for our lord and savior DPR', for example, Astro credited Ulbricht with inventing 'the best fucking way' to 'delete the harm' of 'drug dealing'.

No mafia, no violence, no harm, everyone had what the fuck he/she wanted without the risk and knowing that what he was buying was effectively what he bought. ... The real criminal here is the judge and all the other puppets on the hand of the mafia. I hope that one day not too far we will be all free [to be] doing drugs in a safe and well-informed environment.

In a separate thread in Agora, FoxtrotTango expressed a similar sentiment in an 805-word post. '[Ulbricht] freed people from street-crime and ... gangs and anything else that goes along with street dealing/buying [He] set out on a path ... to get rid of all of these things'. In Silk Road, 'otherwise law-abiding citizens causing no harm could somehow have the privacy to make their own free choices'.

Several forum discussants situate the trial in an ideological contest. A few days after Ulbricht was found guilty, forum member OntheRoad reflected on the implications of an alleged law enforcement hacking of Silk Road 'for internet freedom and anonymity'. 'It'll be interesting to see how everyone will continue to be monitored more and more slowly'. Kaput said that he also expects increased surveillance. 'I'm so glad that my old man didn't live to see this – we've constructed much the same type of society that they went over to Europe to fight against so many decades ago'. OntheRoad replied:

For the [United] States, this century is going to be a tipping point in their political and social statuses. If the people get fed up enough with the government's shit, then perhaps a huge shift of power is within [sight]. If they allow it to continue at the pace it is, I have no doubt in concurring with you that we could be looking at the dawning of a second Nazi Germany. With the level of thought control and censorship, it seems like some major steps have been taken in that direction already.

In an Evolution thread titled 'Do you think Ross Ulbricht was a bad guy or revolutionary?' Simmers wrote that 'their' action is required.

[Ulbricht] was revolutionary in his idea but we need to continue it ... Marijuana needs to be legal again and this has to be our first step if we want him out and thank him for his 'idea'. Only if we succeed in opening peoples mind we all can life free and thats what we ultimativly all want ... people that are willing to already risk their life for this ... we for sure can all combined push the legalization in the US to a point were it will soon happen and if it happens there it happens in the whole western world.

A few days after the life-sentencing, Knife wrote that he is unsurprised by the severity of the punishment, because 'they were always going to make an example of Ross'. The

sentence ‘is a harsh warning to anyone who promotes liberty (freedom of the individual not subject to state control). I think we already knew our enemy but now we have the facts’.

Other members see cryptotrading as part of a social movement against excessive policing of drug use. Vendor [U_Tell_Me](#) said that Silk Road ‘really has changed how drugs are sold’ and claims that Ulbricht may ‘one day be a hero’, because the war on drugs might end because of his actions. People ‘who run these sites, the vendors who sell product and the customers who purchase product’, will ‘one day be seen as part of the chain of events that destroyed an unjust war on drugs ... These sites are the first step in taking back something that our governments never had a right to take.... Our freedom of choice’. In the Evolution forum, user Chemical expressed a similar sentiment in sound bites:

THE TIME HAS COME ...FOR AN IDEA.....NO government OR ARMY...CAN take it down....dark web markets will prevail....and will never go away....they can take down 100 sites.... 10.000 sellers..... the population want their goodies...a war on drugs...is a war on us....!! ...this is a REVOLUTION...

In a thread titled ‘What happened to Ulbricht?’, Coca suggested that the Silk Road creator is ahead of his time. ‘In a couple years when it’s all legal and they’ve finally realised how much money they can make off it what happens to him then?’ Three-Way’s response was optimistic. ‘I have a very good feeling Ulbricht will get out in a few years’, he said. ‘Who wants to chip in for a presidential pardon?’ Kaput referred to past adjustments in the criminal justice system in his reply:

There is some precedent for what you’re talking about. In the 80s, there was a real fear of crack cocaine. Penalties on crack skyrocketed, despite the fact that the difference between crack cocaine and powdered cocaine is just the addition of some water and baking soda. It’s taken almost 30 years for the disparity in penalties to be addressed. Some of those still serving higher penalties have now been released as a result.

Forum posters reject the image of Ulbricht as a morally reprehensible criminal who caused harm by facilitating trade of addictive drugs that has ‘clear social costs’, as Judge Forrest put it ([U.S. v. Ulbricht 2015](#): 78). This criticism was neutralized: first by being ignored, second by claims of cryptomarkets reducing harm and third by shifting the conversation to over-policing of human behaviour. Posters highlight historic and contemporary examples of misgovernance—e.g. mass-surveillance of citizens, the persecution of Galileo and the ‘war on drugs’—and imagine a more liberal society in which drug use is a personal choice and not a criminal offence. Silk Road, they claimed, was advancing an ideological project to combat these forces of social control.

[Sykes and Matza \(1957\)](#) proposed five neutralization techniques that lawbreakers use to rationalize their deviation from dominant social norms. One of them, the appeal to higher loyalties, is particularly relevant to the forum data: If certain norms are held higher than those inscribed in the law, people might break it (p. 669). The demands of the larger society might be neutralized by the demands of smaller groups to which the individual belongs. While it is certainly possible that there was a strong bond between cryptomarket users and that solidarity to the group shaped their opinions and thereby influenced their actions, the forum posters spoke of society over government. In their critique of the present, they related to the historical past and hopes for the future. As further noted by Sykes and Matza, the validity of the neutralizing views is less important

than their neutralizing functions (p. 668). It is the justification that makes illegal acts possible (p. 666).

A child

Ulbricht was also lambasted for the numerous mistakes he made as a marketplace operator, which were revealed in court and disseminated in the forums via trial transcripts and media articles. Pandora, who earlier compared Ulbricht to Galileo, said that ‘deification makes worshippers blind to the fatal flaws that have done as much harm as good’. To Hemingway, Ulbricht ‘was not a hero and became arrogant as time went on. Also let’s not forget all the help he had from people even better than him, specifically [Variety Jones], who made off like the true bandit after the fall of srl’. That Variety Jones was ultimately arrested because Ulbricht kept a scanned copy of his passport on his personal laptop (Greenberg 2015) underlines the point that posters made—Ulbricht ‘messed up by leaving all the evidence to be so easily found’, as Liberty put it. Punch said:

Looking at some of the exhibits for the prosecution I am stunned by how stupid Ross actually was ... What did it for me was the screenshot taken from his laptop showing the id’s of his staff. He actually names the file after the staff member’s [Silk Road] pseudonym. WTF was he doing?

Downfall referred to further details coming out of the court:

[Law enforcement said] that they found a text file called ‘keys’ on the laptop, and this is where ross kept his pgp password. [I] don’t understand how you could be so chased after [by] LE and then just do this. Every day. Walking round with the laptop. Being DPR. With everything right there, knowing if LE get the laptop, they get everything.

In the Evolution forum, Knife said that Ulbricht was ‘an absolute cement-head, when it came to security’, and like others he said he was baffled by some of the details that came out of the trial.

[I] am not easy to shock, but some of what came out during his trial I found shocking ... Ross apparently kept his PGP passphrase in a folder called ‘keys’ on his laptop. My jaw dropped when I heard this – this means that the Feds didn’t even have to lift a finger to decrypt all the data encrypted with Ross’s [encryption] key – the information was sitting there, waiting for them. This is such a fundamental breach of security practices that it isn’t funny.

NoHell, also in the Evolution forum, said Ulbricht ‘deserves’ his punishment because of the mistakes he made. ‘The technology that we use’ is ‘secure’, and ‘yet people are still failing due to human error, they got fucked because of their mouths and shit opsec [operational security]. Ross deserves it tbh purely because he should of known better’. Many posters supplemented their critique of Ulbricht with advice. 1990, for example, said ‘I certainly hope that all vendors read these transcripts and learn what NOT to do by learning from DPR’s lax security of his own laptop’. After reading that most evidence against Ulbricht was easily obtained because his password was available to law enforcement agents, Tino said he will step up his own security practices. ‘Going to change all my passwords to a minimum 12-word cryptic diceword pass in 3 different languages with special characters. If you never see me online again, it’ll be because I opsec’d too hard’.

Some posters say that the many mistakes suggest that Ulbricht was simply unable to control his creation, and at times they appear to pity him. On the day of the sentencing, Hansa wrote that he sees Ulbricht not ‘as a criminal or a kingpin’, but as ‘a scared shitless kid who ... was way out of his depth ... Ross was way too unexperienced to partake in a criminal enterprise’. Anonjon expressed a similar view. ‘He wasn’t mentally prepared for the position he put himself in ... You can tell from the ... chat [logs presented in court] that he was just in too deep. At some points, he just sounded like a scared and confused kid, which I suppose that’s actually what he was’. Kaput stressed that despite his ‘good’ intentions, the outcomes of Ulbricht’s actions for other cryptomarket actors was devastating.

[Ulbricht] had some excellent ideas. However he fatally screwed-up the implementation of those ideas, leading not only to the destruction of his own life, but those of his associates who were fools enough to trust him. If anyone appears to have done it correctly, it was Backcopy, [the administrator of another cryptomarket who is yet to be apprehended].

Forum members say that Ulbricht was at least partially responsible for the trial outcome—not because his lawbreaking caused social harm, but because he was ‘careless’, ‘in over his head’, and despite his good intentions, ‘screwed-up’ and ‘messed up’ the implementation of his ideas. Moreover, he was ‘arrogant’, he did not ‘listen to those who tried to help’ him improve his security practices. The moral judgement of Ulbricht’s actions regarded not the facilitation of illegal trade, but his failure to protect his peers. Implicit and at times explicit in the posts is the argument that people who are careful about their operational security will not end up in the same situation. This suggests that customers and vendors continued to have faith in the expert systems that brought people to cryptomarkets in the first place, e.g. the ‘Tor anonymity network’ that [Silk Road Staff \(2011\)](#) foregrounded in their early public relations efforts. As one poster put it, people are ‘failing due to human error’.

Conclusion

Media reports that illuminate the efforts of law enforcement to halt cryptomarket trade did not reduce market revenue in any of the three regions—instead, periods with increased media exposure were followed by increased trade. This finding suggest that law enforcement’s public relations work and publicized intelligence operations failed to lift actors’ subjective perception of risk, and ultimately did not deter trade.

Neither the conviction nor the sentencing of Silk Road’s creator had measurable deterrent effects on cryptomarket trade. Trade increased significantly after the conviction, and also after the sentencing. These findings arguably undermine the imperative of a ‘very, very serious’ punishment on the defendant, as stated by Judge Forrest in the trial ([U.S. v. Ulbricht 2015](#)), and contest the claim that highly publicized punishment events may generate deterrent effects ([Kleck et al. 2005](#)). Broadly, the findings add to a growing consensus in the literature, that there is insufficient evidence to claim that severe punishment deters crime ([Nagin 1998](#); [Paternoster 2010](#); [Nagin 2013a, 2013b](#)). Albeit it is impossible to know if trade in cryptomarkets would have grown more rapidly and extensively if it was not for the criminal justice work discussed in this paper, there is sufficient evidence to question the efficacy of severe punishment of people who conducts digital trade of illegal goods and services.

Forum discussion data suggest that many cryptomarket actors have more-than-instrumental goals. People appeal to loyalties that are above the law, such as libertarian ideology and resistance to excessive policing, and this neutralization technique might have enabled them to justify rule-breaking (Sykes and Matza 1957). It is also possible that enforcement of the law egged on the behaviour it sought to stop, because market actors strongly believed the control efforts were unjust—ideologically motivated cryptomarket actors might see trade as an imperative transgression, rather than a moral wrong. Moreover, the trial might have assuaged the fears of vendors and customers, as the prosecutor’s evidence suggest that it was human error that led law enforcement on to Ulbricht, rather than newfound capabilities to track down cryptomarket users. Discussions in cryptomarket forums portray Ulbricht as a ‘careless’ and ‘scared kid’ who was ‘out of his depth’, and between the lines here it is suggested that someone who is careful, disciplined and competent will not end up behind bars.

REFERENCES

- ALDRIDGE, J. and DÉCARY-HÉTU, D. (2014), *Not an ‘Ebay for Drugs’: The Cryptomarket ‘Silk Road’ as a Paradigm Shifting Criminal Innovation*. Social Science Research Network.
- ALDRIDGE, J. and DÉCARY-HÉTU, D. (2016a), ‘Hidden Wholesale: The Drug Diffusing Capacity of Online Drug Cryptomarkets’, *International Journal of Drug Policy*, 35: 7–15.
- ALDRIDGE, J. and DÉCARY-HÉTU, D. (2016b), ‘Cryptomarkets and the Future of Illicit Drug Markets’, in EMCDDA, ed., *Internet and Drug Markets, EMCDDA Insights*, 23–30. Publications Office of the European Union.
- APEL, R. (2013), ‘Sanctions, Perceptions, and Crime: Implications for Criminal Deterrence’, *Journal of Quantitative Criminology*, 29: 67–101.
- Australian Associated Press (2015), ‘Aust Silk Road Accused in Plea Talks’, available online at News.com.au (26 February 2015; Web 6 August 2015).
- BACHMAN, R., PATERNOSTER, R. and WARD, S. (1992), ‘The Rationality of Sexual Offending: Testing a Deterrence/Rational Choice Conception of Sexual Assault’, *Law and Society Review*, 26: 343–72.
- BANCROFT, A. and REID, P. S. (2015), ‘Concepts of Illicit Drug Quality among Darknet Market Users: Purity, Embodied Experience, Craft and Chemical Knowledge’, *International Journal of Drug Policy*, 35: 42–9.
- BARRATT, M. J. (2012), ‘Silk Road: eBay for Drugs’, *Addiction*, 107: 683.
- BARRATT, M. J. and ALDRIDGE, J. (2016), ‘Everything You Always Wanted to Know about Drug Cryptomarkets* (*But Were Afraid to Ask)’, *International Journal of Drug Policy*, 35: 1–6.
- BARRATT, M. J., FERRIS, J. A. and WINSTOCK, A. R. (2016a), ‘Safer Scoring? Cryptomarkets, Social Supply and Drug Market Violence’, *International Journal of Drug Policy*, 35: 24–31.
- BARRATT, M. J., LENTON, S. and ALLEN, M. (2013), ‘Internet Content Regulation, Public Drug Websites and the Growth in Hidden Internet Services’, *Drugs: Education, Prevention and Policy*, 20: 195–202.
- BARRATT, M. J., LENTON, S., MADDOX, A. and ALLEN, M. (2016b), ‘“What If You Live on Top of a Bakery and You Like Cakes?”—Drug Use and Harm Trajectories before, during and after the Emergence of Silk Road’, *International Journal of Drug Policy*, 35: 50–7.
- BECKERT, J. and WEHINGER, F. (2012), ‘In the Shadow: Illegal Markets and Economic Sociology’, *Socio-Economic Review*, mws020.

- BERK, R. (2005), 'New Claims about Executions and General Deterrence: Déjà Vu All Over Again?', *Journal of Empirical Legal Studies*, 2: 303–30.
- BOHR, J. and BASHIR, M. (2014), 'Who Uses Bitcoin? An Exploration of the Bitcoin Community', in *Privacy, Security and Trust (PST), 2014 Twelfth Annual International Conference*, 94–101, 23–24 July. IEEE.
- BOS, N., OLSON, J., GERGLE, D., OLSON, G. and WRIGHT, Z. (2002), 'Effects of Four Computer-Mediated Communications Channels on Trust Development', in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 135–40, 20–25 April. ACM.
- CHAYKO, M. (2008), *Portable Communities: The Social Dynamics of Online and Mobile Connectedness*. Suny Press.
- CHEN, A. (2011), 'The Underground Website Where You Can Buy Any Drug Imaginable', available online at, <http://gawker.com/the-underground-website-where-you-can-buy-any-drug-imag-30818160> *Gawker*, 1 June 2011 (accessed 11 June 2016).
- CHRISTIN, N. (2013), 'Traveling the Silk Road: A Measurement Analysis of a Large Anonymous Online Marketplace', in *Proceedings of the 22nd International Conference on World Wide Web*, 213–24, 13–17 May. International World Wide Web Conferences Steering Committee.
- CHRISTIN, N. (2014), 'Commentary on Barratt *et al.* (2014): Steps towards Characterizing Online Anonymous Drug Marketplace Customers', *Addiction*, 109: 784–5.
- COOK, T. D., CAMPBELL, D. T. and DAY, A. (1979), *Quasi-experimentation: Design & Analysis Issues for Field Settings*, vol. 351. Houghton Mifflin.
- CUNNINGHAM, J. K. and LIU, L. M. (2003), 'Impacts of Federal Ephedrine and Pseudoephedrine Regulations on Methamphetamine-Related Hospital Admissions', *Addiction*, 98: 1229–37.
- CUNNINGHAM, J. K., LIU, L. M. and MURAMOTO, M. (2008), 'Methamphetamine Suppression and Route of Administration: Precursor Regulation Impacts on Snorting, Smoking, Swallowing and Injecting', *Addiction*, 103: 1174–86.
- CURRIE, E. (1985), *Confronting Crime: An American Challenge*, 11–24. Pantheon Books.
- DUGAN, L. (2010), 'Estimating Effects Over Time for Single and Multiple Units', in *Handbook of Quantitative Criminology*, 741–763. Springer.
- DECKER, S., WRIGHT, R. and LOGIE, R. (1993), 'Perceptual Deterrence among Active Residential Burglars: A Research Note', *Criminology*, 31: 135–47.
- DÉCARY-HÉTU, D. and ALDRIDGE, J. (2015), 'Sifting through the Net: Monitoring of Online Offenders by Researchers', *European Review of Organised Crime*, 2: 122–41.
- DÉCARY-HÉTU, D. and GIOMMONI, L. (2016), 'Do Police Crackdowns Disrupt Drug Cryptomarkets? A Longitudinal Analysis of the Effects of Operation Onymous', *Crime, Law and Social Change*, 67: 55–75.
- DÉCARY-HÉTU, D., PAQUET-CLOUSTON, M. and ALDRIDGE, J. (2016), 'Going International? Risk Taking by Cryptomarket Drug Vendors', *International Journal of Drug Policy*, 35: 69–76.
- DEMANT, J., MUNKSGAARD, R. and HOUBORG, E. (2016), 'Personal Use, Social Supply or Redistribution? Cryptomarket Demand on Silk Road 2 and Agora', *Trends in Organized Crime*, 1–20.
- DEZHBAKHSH, H., RUBIN, P. H. and SHEPHERD, J. M. (2003), 'Does Capital Punishment Have a Deterrent Effect? New Evidence from Postmoratorium Panel Data', *American Law and Economics Review*, 5: 344–76.
- DEZHBAKHSH, H. and SHEPHERD, J. M. (2006), 'The Deterrent Effect of Capital Punishment: Evidence from a 'Judicial Experiment'', *Economic Inquiry*, 44: 512–35.

- DICKINSON, T. and WRIGHT, R. (2015), 'Gossip, Decision-Making and Deterrence in Drug Markets', *British Journal of Criminology*, 55: 1263–81.
- DONOHUE III, J. J. and WOLFERS, J. (2006), *Uses and Abuses of Empirical Evidence in the Death Penalty Debate (No. w11982)*. National Bureau of Economic Research.
- Dread Pirate Roberts (@DreadPirateSR). 'We're at Over 20,000 Registrants Already. Amazing Show for #Freedom #Silkroad and #Theidea', *Tweet*, 7 November 2013.
- FAGAN, J. (2006), 'Death and Deterrence Redux: Science, Law and Casual Reasoning on Capital Punishment', *Ohio State Journal of Criminal Law*, 4: 255.
- FBI New York (@NewYorkFBI). 'RTSilk Road = Road to Prison', *Tweet*, 6 November 2014.
- GIBBS, J. P. (1975), *Crime, Punishment, and Deterrence*, 58. Elsevier.
- GIDDENS, A. (1991), *Modernity and Self-identity: Self and Society in the Late Modern Age*. Stanford University Press.
- GIDDENS, A. (1996), *The Consequences of Modernity*. Polity Press.
- GRASMICK, H. G. and BURSİK JR, R. J. (1990), 'Conscience, Significant Others, and Rational Choice: Extending the Deterrence Model', *Law and Society Review*, 24: 837–61.
- GREENBERG, A. (2013), 'End of the Silk Road: FBI Says It's Busted the Web's Biggest Anonymous Drug Black Market', available online at Forbes.com (2 October 2013; Web 6 August 2015).
- GREENBERG, A. (2015), 'Variety Jones, Alleged Silk Road Mentor, Arrested in Thailand', available online at Wired.com (4 December 2015; Web 3 August 2016).
- HARDY, R. A. and NØRGAARD, J. R. (2016), 'Reputation in the Internet Black Market: An Empirical and Theoretical Analysis of the Deep Web', *Journal of Institutional Economics*, 12: 515–39.
- HIRTENLEHNER, H., PAUWELS, L. J. and MESKO, G. (2013), 'Is the Effect of Perceived Deterrence on Juvenile Offending Contingent on the Level of Self-control? Results from Three Countries', *British Journal of Criminology*, 54: 109–27.
- HOLT, T. J., SMIRNOVA, O. and HUTCHINGS, A. (2016), 'Examining Signals of Trust in Criminal Markets Online', *Journal of Cybersecurity*, 2: 137–45.
- HORNEY, J. and MARSHALL, I. H. (1992), 'Risk Perceptions among Serious Offenders: The Role of Crime and Punishment', *Criminology*, 30: 575–94.
- HYNDMAN, R. J. and ATHANASOPOULOS, G. (2014), *Forecasting: Principles and Practice*. OTexts.
- HYNDMAN, R. J. and KHANDAKAR, Y. (2008), 'Automatic Time Series Forecasting: The Forecast Package for R', *Journal of Statistical Software*, 26: 1–22.
- JORDAN, T. and TAYLOR, P. (1998), 'A Sociology of Hackers', *The Sociological Review*, 46: 757–80.
- KLECK, G. and BARNES, J. C. (2014), 'Do More Police Lead to More Crime Deterrence?', *Crime & Delinquency*, 60, 716–38.
- KLECK, G., SEVER, B., LI, S. and GERTZ, M. (2005), 'The Missing Link in General Deterrence Research', *Criminology*, 43: 623–60.
- KLEPPER, S. and NAGIN, D. (1989), 'The Deterrent Effect of Perceived Certainty and Severity of Punishment Revisited', *Criminology*, 27: 721–46.
- KOSKI, A., SIRÉN, R., VUORI, E. and POIKOLAINEN, K. (2007), 'Alcohol Tax Cuts and Increase in Alcohol-Positive Sudden Deaths—A Time-Series Intervention Analysis', *Addiction*, 102: 362–8.
- KRUTHOF, K., ALDRIDGE, J., DÉCARY-HÉTU, D., SIM, M., DUJSO, E. and HOORENS, S. (2016), *Internet-Facilitated Drugs Trade*. RAND Corporation.

- LOCHNER, L. (2007), 'Individual Perceptions of the Criminal Justice System', *The American Economic Review*, 97: 444–60.
- MADDOX, A., BARRATT, M. J., ALLEN, M. and LENTON, S. (2016), 'Constructive Activism in the Dark Web: Cryptomarkets and Illicit Drugs in the Digital "Demimonde"', *Information, Communication & Society*, 19: 111–26.
- MARTIN, J. (2014a), 'Lost on the Silk Road: Online Drug Distribution and the "Cryptomarket"', *Criminology and Criminal Justice*, 14: 351–67.
- MARTIN, J. (2014b), *Drugs on the Dark Net: How Cryptomarkets Are Transforming the Global Trade in Illicit Drugs*. Palgrave Macmillan.
- McDowall, D. (1980), *Interrupted Time Series Analysis*, Vol. 21. Sage.
- MEIKLEJOHN, S., POMAROLE, M., JORDAN, G., LEVCHENKO, K., MCCOY, D., VOELKER, G. M. and SAVAGE, S. (2013, October). 'A Fistful of Bitcoins: Characterizing Payments among Men With No Names', in Proceedings of the 2013 Conference on Internet Measurement Conference, 127–40, 23–25 October. ACM.
- MOCAN, H. N. and GITTINGS, R. K. (2001), *Pardons, Executions and Homicide (No. w8639)*. National Bureau of Economic Research.
- MUNKSGAARD, R. and DEMANT, J. (2016), 'Mixing politics and crime—The prevalence and decline of political discourse on the cryptomarket', *International Journal of Drug Policy*, 35: 77–83.
- NAGIN, D. S. (1998), 'Criminal Deterrence Research at the Outset of the Twenty-First Century', *Crime and Justice*, 23: 1–42.
- NAGIN, D. S. (2013a), 'Deterrence in the Twenty-First Century', *Crime and Justice*, 42: 199–263.
- NAGIN, D. S. (2013b), 'Deterrence: A Review of the Evidence by a Criminologist for Economists', *Annual Review of Economics*, 5: 83–105.
- NAGIN, D. S. and POGARSKY, G. (2001), 'Integrating Celerity, Impulsivity, and Extralegal Sanction Threats into a Model of General Deterrence: Theory and Evidence', *Criminology*, 39: 865–92.
- National Crime Agency (NCA) (2013), 'NCA Arrests Silk Road Suspects', National Crime Agency, *Tweet*, 22 August 2016.
- PATERNOSTER, R. (2010), 'How Much Do We Really Know About Criminal Deterrence?', *The Journal of Criminal Law and Criminology*, 765–824.
- PATERNOSTER, R. and SIMPSON, S. (1996), 'Sanction Threats and Appeals to Morality: Testing a Rational Choice Model of Corporate Crime', *Law and Society Review*, 30: 549–83.
- PFEIFFER, C., WINDZIO, M. and KLEIMANN, M. (2005), 'Media Use and Its Impacts on Crime Perception, Sentencing Attitudes and Crime Policy', *European Journal of Criminology*, 2: 259–85.
- PILIAVIN, I., GARTNER, R., THORNTON, C. and MATSUEDA, R. L. (1986), 'Crime, Deterrence, and Rational Choice', *American Sociological Review*, 51: 101–19.
- Reuters (2013), 'New Silk Road Drug Bazaar Opens a Month after FBI Bust', available online at Reuters.com (7 November 2013; Web 6 August 2015).
- Silk Road Staff (2011), 'This Is Not the Silk Road, But You Are Close...' This Is Not the Silk Road, But You Are Close...', available online at Silkroadmarket.org (4 March 2011; Web 12 October 2016).
- SINDALL, K., STURGIS, P. and JENNINGS, W. (2012), 'Public Confidence in the Police: A Time-Series Analysis', *British Journal of Criminology*, 52: 744–64.

- SOSKA, K. and CHRISTIN, N. (2015), 'Measuring the Longitudinal Evolution of the Online Anonymous Marketplace Ecosystem', in *Proceedings of the 24th USENIX Conference on Security Symposium*. USENIX Association, 33–48.
- SYKES, G. M. and MATZA, D. (1957), 'Techniques of Neutralization: A Theory of Delinquency', *American Sociological Review*, 22: 664–70.
- The Star. (2015), 'Internet Drug Highway Key Player Arrested, FBI', available online at thestar.com (21 January 2015; Web 6 August 2015).
- TEEVAN, J. J. (1976), 'Subjective Perception of Deterrence (Continued)', *Journal of Research in Crime and Delinquency*, 13: 155–64.
- THOMAS, K. V., BIJLSMA, L., CASTIGLIONI, S., COVACI, A., EMKE, E., GRABIC, R., HERNÁNDEZ, F., KAROLAK, S., KASPRZYK-HORDERN, B., LINDBERG, R. H. and DE ALDA, M. L. (2012), 'Comparing Illicit Drug Use in 19 European Cities through Sewage Analysis', *Science of the Total Environment*, 432: 432–9.
- TZANETAKIS, M., KAMPHAUSEN, G., WERSE, B. and VON LAUFENBERG, R. (2016), 'The Transparency Paradox. Building Trust, Resolving Disputes and Optimising Logistics on Conventional and Online Drugs Markets', *International Journal of Drug Policy*, 35: 58–68.
- US Department of Justice. (2013), 'More Than 400. Onion Addresses, Including Dozens of 'Dark Market' Sites, Targeted as Part of Global Enforcement Action on Tor Network', available online at <https://www.fbi.gov/news/pressrel/press-releases/more-than-400-onion-addresses-including-dozens-of-dark-market-sites-targeted-as-part-of-global-enforcement-action-on-tor-network> US Department of Justice, Office of Public Affairs (30 November 2013; Web 25 August 2016).
- US District Court, Southern District of New York (@SDNYnews). 'Silk Road = Road to Prison', *Tweet*, 6 August 2015.
- U.S. v. Ross William Ulbricht, Defendant* [2015]. Southern District of New York.
- U.S. v. Ross William Ulbricht, Defendant* [Document 251-1, Exhibit 1, 2015]. Southern District of New York.
- VAN BUSKIRK, J., NAICKER, S., ROXBURGH, A., BRUNO, R. and BURNS, L. (2016a), 'Who Sells What? Country Specific Differences in Substance Availability on the Agora Cryptomarket', *International Journal of Drug Policy*, 35: 16–23.
- VAN BUSKIRK, J., ROXBURGH, A., BRUNO, R., NAICKER, S., LENTON, S., SUTHERLAND, R., ... BURNS, L. (2016b), 'Characterising Dark Net Marketplace Purchasers in a Sample of Regular Psychostimulant Users', *International Journal of Drug Policy*, 35: 32–37.
- VAN HOUT, M. C. and BINGHAM, T. (2013a), "'Silk Road", the Virtual Drug Marketplace: A Single Case Study of User Experiences', *International Journal of Drug Policy*, 24: 385–91.
- VAN HOUT, M. C. and BINGHAM, T. (2013b), "'Surfing the Silk Road": A Study of Users' Experiences', *International Journal of Drug Policy*, 24: 524–9.
- VAN HOUT, M. C. and BINGHAM, T. (2014), 'Responsible Vendors, Intelligent Consumers: Silk Road, the Online Revolution in Drug Trading', *International Journal of Drug Policy*, 25: 183–9.
- Vásquez, B. E., MADDAN, S. and WALKER, J. T. (2008), 'The Influence of Sex Offender Registration and Notification Laws in the United States: A Time-Series Analysis', *Crime & Delinquency*, 54: 175–92.
- WALL, D. (2007), *Cybercrime: The Transformation of Crime in the Information Age*, vol. 4. Polity.
- ZELIZER, V. A. R. (1997), *The Social Meaning of Money*. Princeton University Press.
- ZIMRING, F. E. and HAWKINS, G. J. (1973), *Deterrence: The Legal Threat in Crime Control*. University of Chicago Press.