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ABSTRACT

Scientific Advancements in Illegal Drugs Production and Institutional Responses: New Psychoactive Substances, Self-Harm, and Violence inside Prisons

Incarceration is a crucial part of the scholarly analysis of crime, but what happens inside penal institutions largely remains a 'black box' (Western, 2021). This paper studies the impact of the new psychoactive substances (NPS) epidemic within prisons. NPS are powerful addictive chemical compounds that mimic the pharmacological effects of conventional drugs of abuse (CDA) but avoid classification as illegal and detection in standard drug tests. To conduct the analysis, I have assembled a novel establishment-by-month database of all England and Wales prisons from 2007 to 2018 including information on drugs seizures, random mandatory drug test results, various measures of harm, violence, and causes of death. I first document a large increase in NPS availability and an alarming correlation with the steep rise in harm and violence behind bars. I then evaluate the impact of the Psychoactive Substances Act 2016, a supply-side intervention aimed at inhibiting the proliferation of NPS. The analysis exploits cross-prison variation in the initial size of the drug market and shows high-intensity NPS trafficking prisons experienced a sustained but partial reduction in NPS availability, limited substitution toward CDA, and a rise in violence, self-harm, and suicides following the law. Collectively, the findings suggest unwarranted responses to government interventions may be amplified within penal institutions and that new challenges stemming from scientific advances in illegal drugs production should be addressed through systemic interventions that also consider the demand for addictive substances.

JEL Classification: I18, K14, K42

Keywords: illegal drugs, new psychoactive substances, prisons, violence, self-harm, supply-side intervention

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1. Introduction

In the last decades, science, technology, and the new wave of globalization have dramatically transformed most aspects of our life. The fruits of this dramatic change have greatly benefited criminal organizations, allowing them to expand their reach, the scale of illegal operations, and ultimately, their profits. Drug production and drug trafficking are at the core of these illegal activities and have fuelled transnational criminal organizations causing inestimable health, social, and economic damages across the globe (UNODC, 2021). The situation is now evolving, probably for the worse. In fact, the already difficult challenges imposed on governments, policymakers, and law enforcement agencies by the expansion of traditional drug markets are being exacerbated by scientific and technological advances in the production of new psychoactive substances (NPS). These new highly dangerous substances are scientifically designed to mimic the pharmacological effects of conventional drugs of abuse (CDA)—such as cocaine, methamphetamine, and heroin—whilst being cheaper, more potent and addictive, also avoiding classification as illegal and detection in standard drug tests.

The emergence of NPS has involved extensive exploitation of the scientific and patent literature to identify novel substances unregulated by the existing legislation. The production of a handful of these substances started off in small-scale illegal laboratories; it then evolved into large-scale production of numerous new drugs manufactured in chemical and pharmaceutical companies operating predominantly in China and India (Sumnall et al. 2011). The connectivity offered by the internet has intensified this expansion, facilitating access to methods of drug synthesis across the globe and increasing the demand for these drugs, enabling the online sale of NPS by multiple suppliers in countries with weak or differing regulatory frameworks.

This paper examines the impacts of these new drugs within the prison system, a hotbed for illegal drugs usage, where marginalized populations, addiction, and mental health problems are heavily concentrated. To conduct the analysis, I have assembled a novel establishment-by-month database on all England and Wales prisons, from March 2007 to April 2018, including information on drugs seizures, random mandatory drug test results, numerous measures of harm, violence, causes of death, as well as other prison characteristics. These newly assembled data combining information on supply, demand, and drug-related harms allow to document the spreading and the effects of NPS in a rather understudied environment: Whilst incarceration is a crucial part of the scholarly analysis of crime, what happens inside penal institutions largely remains a 'black box' (Western, 2021).

I start the analysis by documenting the emergence of the NPS epidemic inside prisons and the worrying correlation with the steep rise in violence and self-injurious behaviour among inmates. This correlation is specific to NPS, and it is less pervasive for other CDA. This first part of the work lays the foundations for the subsequent analysis examining the impact within the prison system of a government intervention targeting the supply of NPS. Specifically, I focus on the Psychoactive Substances Act (PSA), a total ban on the open

sale of NPS.[2] The PSA was implemented across the United Kingdom in May 2016, and it has introduced offences for the production, possession with intent to supply, the supply, import, export, and consumption (only in prison) of psychoactive substances defined by the Act as 'all drugs capable of affecting the person's mental functioning or emotional state by stimulating or depressing the person's central nervous system'.

I address the challenge of identifying the causal effects of a national intervention separately from other policy and secular trends by exploiting cross-prison variation in the initial size of this drug market, arguing the supply-side intervention should have more 'bite' in prisons with a larger initial market for NPS. A difference in differences analysis reveals a reduction of around 28% in NPS finds in high-intensity NPS trafficking (HINPST) prisons, which I later argue is likely to be a lower bound of the true reduction in NPS availability following the law. Findings from the single coefficient model are corroborated by the event study analysis, which shows the absence of significant pre-trends, and effects lasting 20 months after the Act until the end of the sample. The estimates suggest the policy has reduced NPS availability in prison by around 11 kilograms, or around 220,000 drug doses.

The scope of the PSA may have been limited by substitution responses originating from both the supply and the demand side of the market (Alpert et al. 2018). The crackdown on NPS has affected criminal operations, plausibly reducing illegal revenues, thus incentivizing the trafficking of other illicit substances inside prisons. Also, numerous qualitative studies suggest NPS scarcity induced by the PSA has led to a price increase in the range of 80% to 300% (Ralphs et al. 2017; Shapiro and Daily, 2017; Home Office, 2018). By increasing the cost of usage, the reform may have led existing consumers to substitute NPS with other CDA. The event study analysis reveals some signs of an increase in seizures and positive drug tests for cannabis and cocaine. Cannabis and cocaine represent the natural substitutes for 'spice' (synthetic cannabinoid) and 'bath salts' (synthetic cathinone) the most prevalent NPS in UK prisons. The analysis also suggests the law led to delayed substitution responses, presumably because of the time needed by drug traffickers to react to the policy and find new routes inside prison.

I then examine the impact of the PSA on violence. Coupled with the inelastic demand for addictive substances, the price hike is likely to have enhanced the profitability of the drug trade, affecting the offenders' expected utility of employing systemic violence to operate in the drug market (Goldstein, 1985). Lower availability and the price increase are also expected to diminish drug consumption, reducing violence committed by users 'under the influence', but increasing psychotic and violent behaviour due to withdrawal symptoms or the fear of experiencing its heavy effects. The event study estimates reveal a significant increase in serious assaults and non-natural deaths among prisoners. The estimates, likely capturing the net impact of the policy arising from the systemic and psychotic channels

[2] Before the law, the legal sale of NPS was typically carried out in licensed head shops or online in the form of plant fertilizers, bath salts, and herbal incense.

just discussed, suggest the PSA has caused around 232 serious assaults and 10 non-natural deaths.

Then, we turn our attention toward self-injurious behaviour. The rising usage of NPS has become a significant medical concern, causing growing challenges for clinicians working in both mental health and emergency departments, with suicidality and self-harm being frequently associated with the use of NPS (Chiappini et al. 2021). Lower availability and higher prices make it more difficult for habitual consumers to maintain a regular drug intake, also reducing the value of drug use, as heavy withdrawal symptoms are alleviated less frequently (Borgschulte et al. 2018). Therefore, the PSA may have led drug habits to become unsustainable for some individuals suffering from severe addiction and mental health problems, leading to undesired effects. The event study analysis shows a significant increase in self-harm and suicide emerging right after the implementation of the Act and mitigating in the subsequent periods. This suggests users were able to adjust after being hit hard by the PSA, probably due to a mix of gradual adaption to the reduced availability of NPS and the subsequent substitution toward other substances. The analysis suggests the PSA has generated around 725 episodes of self-harm and 8 self-inflicted deaths.

Finally, I show the findings are unlikely to be driven by an increase in the number of inmates due to the implementation of the PSA, or by a worsening of the prison's conditions. Also, no evidence of an increase in violence against prisons staff and inmates' protests is detected. This suggests anger or despair due to harsher sentences is not driving the increase in violence and self-injurious behaviour identified in this study. Collectively, the findings suggest unwarranted responses to government interventions may be amplified within closed penal institutions and new challenges stemming from scientific advances in illegal drugs production should be addressed through more systemic interventions that also consider the demand for addictive substances.

Related Literature. Academically, this paper contributes to and builds on various strands of the economic literature. Extensive compelling evidence exists on the impacts of imprisonment on recidivism and various health and socio-economic outcomes (e.g., Grogger 1995; Hjalmarsson 2009; Barbarino and Mastrobuoni 2014; Schnepel 2018; Mastrobuoni and Terlizzese 2018; Billings and Schnepel 2020; Bhuller et al. 2020; Hjalmarsson and Lindquist 2020; Doleac 2020). However, very little is known about what happens inside penal institutions. Two notable exceptions are Campaniello et al. (2019) and Mukherjee and Sanders (2021). Campaniello et al. (2019) rationalize self-injurious behaviour showing suicides rates in prisons are significantly lower when pardons are proposed in congress. Mukherjee and Sanders (2021) find that high temperatures increase violence within prisons that commonly lack climate control. My paper contributes to the understanding of within-prison violence by showing that a ban on highly addictive substances can incentivize self-injurious behaviour, suicides, and assaults in prisons where NPS are heavily trafficked.

Various studies have looked at the impacts of intervention targeting the supply of addictive substances (Dobkin and Nicosia 2009; Dobkin et al. 2014; Dell 2015; d'Este 2021; Moore and Schnepel 2021). The emerging evidence suggests interventions somewhat capable of disrupting the market for drugs are at best ineffective in deterring violence—and at worse can backfire—increasing drug-related violence in the short and medium term.[3] I identify violent responses emerging because of the policy; therefore, my study extends the external validity of this literature by focusing on an important setting where drugs and violence are heavily concentrated. Also, my work on new highly dangerous drugs enriches the literature on the negative impacts of conventional drugs of abuse such as crack cocaine (Grogger and Willis 2000; Fryer et al. 2013), opioids (Moore and Schnepel 2021; Powell and Pacula 2021), and cannabis (Mark Anderson et al. 2013; Hansen et al. 2020).

This work also extends the literature on the economic and social determinants of suicide (Cutler et al. 2001; Stevenson and Wolfers 2006; Ludwig et al. 2009; Daly et al. 2013; Becker and Woessmann 2018) showing the impact of the PSA on self-injurious behaviour likely committed by drug users experiencing a sudden increase in the cost of addiction. The results are consistent with the recent work of Tibbits and Cowan (2021) showing that the Opioid Safety Initiative, which discourages prescription opioids dependence among veteran patients in the US, has increased the number of veterans suicides. Another related paper by Borgschulte et al. (2018) studies the impact that Prescription Drug Monitoring Programs for opioids have on suicides in the US. They find these supply-side interventions reduce suicides, but only in places where strong addiction-help networks and treatment services are available to the general population.[4]

Finally, this paper focuses on the scientific and technological advances in the production of illicit drugs, and it contributes to the small but growing literature studying the use of new technologies by criminals (e.g., Bhuller et al. 2013, Bhaskar et al. 2019; Foley et al. 2019) and, more generally, highlights the need for the criminal justice system of adopting new technologies to keep up with recent criminal developments (Doleac 2017; Mastrobuoni 2020; Anker et al. 2021).

This paper unfolds as follows: Section 2 describes the institutional background; Section 3 presents the newly assembled data; Section 4 discusses the empirical designs; Section 5 presents the results; Section 6 concludes.

[3] Moore and Schnepel (2021) study the effects of a rapid reduction in heroin in Australia, also finding an increase in violence in the short term, but positive effects more in the long term.

[4] The differences in my findings with the work of Borgschulte et al. (2018) may be due to differences in the populations, drugs, and contexts analysed. My work focuses on prisons where the NPS has reached epidemic levels and addiction, desperation, and self-injurious behaviours are extremely common. Also, *ad-hoc* medical treatment services for these new, often unknown, and entirely synthetic drugs are not yet available (Chiappini et al. 2021). Lastly, harm reduction strategies and supportive care that might help prisoners experiencing heavy withdrawal symptoms are rarely provided in UK prisons.

2. Institutional Background

New Psychoactive Substances. Designer drugs, or new psychoactive substances, are substances of abuse that are not controlled by the 1961 Single Convention on Narcotic Drugs, but which may pose a risk to public health (UNODC, 2021). NPS are chemical compounds that have similar properties to a controlled substance. Their design mimics the pharmacological effects of the original drug but avoids classification as illegal, or detection in standard drug tests. In practice, the term NPS refers to synthetic cannabinoids, stimulants, opioids, and hallucinogens originally designed as legal alternatives to cannabis, cocaine, heroin, and amphetamine.

The production of a handful of NPS started off in relatively small-scale illegal laboratories; it then evolved into mass-production of a large range of substances in chemical and pharmaceutical companies operating predominantly in China and in India (Sumnall et al. 2011). The continuous growth of this market involves extensive exploitation of the scientific and patent literature to identify novel addictive substances, with simple alterations in the chemical structure that elude national and international laws.[5] Internet has facilitated knowledge exchange regarding methods of drug synthesis, and it has also raised awareness of these new addictive substances, increasing both supply and demand for these products. Figure 1 shows the number of NPS detected each year in Europe reported to the EU Early Warning System. In 2005, less than 30 varieties of NPS were available in the market. In 2019, around 400. The spreading of NPS is a global phenomenon with high prevalence in Asia, Australia, Europe, and the United States (UNODC, 2021).

Differently from CDA, with well-studied pharmaco-toxicological aspects, poor information exists on NPS mechanisms of action, abuse liability, and toxicity (Pantano et al. 2019). However, the medical literature has documented numerous physical and neuropsychiatric side effects associated with NPS usage, particularly for vulnerable populations such as people with severe mental illness (Chiappini et al. 2021). Before the passage of the law, several surveys indicate a low prevalence among the general population (less than 1%). Usage among youngsters and the homeless were instead relatively high (more than 3%) due to factors such as the legality and novelty of the products, the high addictive power, and—most importantly—the affordability (Grey and Ralphs 2017). A 1.5-gram packet of synthetic cannabinoids legally sold by head shops cost £10 and allowed to make around 20 'joints' or drug doses (Peacock et al. 2019).

NPS in Prison. This study focuses on England and Waled prisons, where the spreading of NPS has reached epidemic levels (Ralphs et al. 2017). Such epidemic has been fuelled by numerous factors. First, NPS are not detected by routine drug tests, an appealing feature for prisoners considering that a positive test result for an unauthorised substance, like

[5] This is the reason why often these substances are referred to as 'legal highs'.

heroin or cannabis, may result in loss of privileges or affect a parole outcome (NOMS 2015). The restrictions in intimate searching facilitate drug-trafficking inside prisons; moreover, compared to other substances, NPS are relatively easier to smuggle as they are often odourless and can be dissolved in a solvent or sprayed on letters (NOMS 2016). Other key features of NPS are the high potency at low volumes and the large accessibility due to the continuous increase in the number of new substances available in the market (Home Office 2018). High profits represent the main motivations behind the decision of criminals to establish this new drug market in prison. At wholesale prices (with purchases of 100 grams or more) an ounce of synthetic cannabinoids—the most available NPS in prison—could be obtained for as little as £84, or £3 per gram via online sellers or high-street head shops. It could be then resold in prison for around £100 per gram (Ralphs et al. 2017).

Psychoactive Substances Act 2016. In response to the growth of the NPS market, the UK Government convened an NPS Review Expert Panel to consider a range of possible measures to address the problem (Reuter and Pardo 2017). The Panel recommended a total ban on all NPS allowing only psychoactive substances specifically exempted, such as alcohol and tobacco. Following this recommendation, the government introduced the Psychoactive Substances Act (PSA) which came into force on 26 May 2016 across the entire United Kingdom.

The PSA had several objectives. First, it aimed at ending the open sale of NPS, both in stores and online, to protect citizens from the risks posed by untested and unknown drugs. Second, it wanted to stop new substances from appearing on the market due to small differences in the chemical make-up capable of bypassing outdated legislation. Ultimately, the PSA aimed at reducing the number of people using psychoactive substances, especially in subpopulations with high prevalence, also reducing hospital admissions, deaths, and violence associated with the spreading of these substances.

To achieve these objectives, the PSA introduced offences for the production, the possession with intent to supply, the supply, the import, or the export of psychoactive substances defined by the Act as all drugs capable of 'affecting the person's mental functioning or emotional state by stimulating or depressing the person's central nervous system'. No possession offence was introduced, other than within a custodial setting.[6] In addition to the criminal offences, the Act also created civil sanctions as an alternative to criminal proceedings to achieve a graded approach to enforcement action. The PSA also gave police powers to seize and destroy psychoactive substances; search persons, premises, and vehicles; and enter premises by warrant.

[6] The maximum penalties are seven years and a fine to produce, supply, possess with intent to supply or import a psychoactive substance, and the maximum penalty for possession in a custodial setting is two years and a fine.

Qualitative Evidence on the PSA's Impact. According to official government documentation, after the law, 332 shops ceased the sale of NPS; the large majority of online NPS vendors in the UK removed NPS from their sites or closed completely; 170 individuals were convicted for PSA-related reasons, with less than 40% entering prison custody in England and Wales (Home Office 2018). Qualitative evidence suggests the PSA caused a change from legal to illegal supply, with NPS readily available in the black market or on the darknet (Ralphs et al. 2017). Unsurprisingly, various reports and ethnographies suggest the restriction in availability has led to a dramatic increase in prices.[7] Before the law, a bag of 1.5 grams purchased from a licensed headshop cost £10. After the law, the price for a similar amount soared to £40 (Grey and Ralphs 2017). Various studies also report a drop in usage among general populations and young people, with limited change in behaviour of marginalized groups and prisoners, suggesting the black market took over the distribution of NPS (Shapiro and Daly 2017; Home Office 2018; O'Hagan and McCormack 2019).

3. Data

To conduct the analysis, I have assembled a novel database gathering and merging information on drug finds, drug tests, harm, violence, protests, and deaths inside England and Wales prisons. This information is provided by the Ministry of Justice, and it is available from various sources.[8] Next, I discuss the details of the data gathering process and the main features of the newly assembled database.

Drug Finds. These data are available at the establishment-by-month level from April 2000 to March 2018 and include the number of incidents where an illicit drug was found. Prior to October 2015, NPS were included in the 'others' category.[9] Additional drugs recorded were amphetamine, barbiturates, cannabis, cocaine, heroin, LSD, and tranquillisers. After October 2015, more categories were added to the list to reflect new developments in the illegal market. These were buprenorphine, methadone, steroids, tramadol, psychoactive, and unknown substances. With this change, prison officers started to record NPS seizures in the 'psychoactive' or in the 'unknown' category, given that most substances were literally unknown at the time of seizure. Also, some officers kept using the 'others' category when referring to seizures of substances difficult to classify, as it is the case for most new varieties of NPS.

For these reasons, the baseline measure of NPS seizures pools together 'other', 'psychoactive', and 'unknown' drug finds. Figure A1 displays the increase of NPS in England and Wales's prisons disaggregated by the three categories. Importantly, the reduction in NPS seizures following the PSA does not depend on the way NPS are

[7] Comprehensive and accurate data on NPS prices do not exist in England and Wales.
[8] Date of last data extraction 2nd of February 2021. Links to various sources provided in the data appendix.
[9] This was the drug group with the most seizures (40% of the total).

classified. In fact, the findings are robust across all possible NPS definitions, also to the most restrictive one exclusively focusing on 'psychoactive substances' recorded in the data only after October 2015 (see Table A1 for more details).

Data sometimes include the weight of the seizure. However, this information is more sporadic and does not allow for a systematic analysis of the quantity of drugs detected in jail. With this caveat in mind, I use available information on the pre-intervention average weight of an NPS seizure (around 5 grams) to provide a back of the envelope calculation of the drop in NPS availability following the law.

Random mandatory drug testing. The prison random mandatory drug testing (RMDT) program was established in 1996.[10] Data on RMDT are available at the establishment-by-month level from April 2007 to March 2018 and provide the number of tests resulting negative and positive for controlled substances. For positive tests, they also provide the type of controlled substance. I report results on positive tests for opioids, cannabis, cocaine, and amphetamines, as these are among the most used drugs in our prisons. Results for other drugs such as methadone, benzodiazepines, and barbiturates are not reported for brevity purposes and are available upon request.[11] Unfortunately, data on positive tests for NPS are only available for the last year of the sample. Therefore, they cannot be used to directly estimate the impact of the law on NPS usage.

Assaults. These data are available at the establishment-by-month level from January 2003 to March 2018. Assaults refer to unwanted physical contact between two or more individuals, excluding lawful use of force by staff or anything of a purely verbal or threatening nature. Recorded episodes of assaults can either be 'serious' or 'not serious'. Serious assaults involve one or more of the following: a sexual assault; violence resulting in detention in an outside hospital as an in-patient or requiring medical treatment for a concussion or internal injuries.[12] Data also report whether the victim of an assault was a prisoner or a staff member.

Deaths. These data are available at the establishment-by-month level from January 2000 to March 2019. All deaths in prison custody are subject to a police investigation and a coroner's inquest. Deaths are recorded as i) natural, ii) homicide, iii) self-inflicted, iv) other-non-natural, v) unclassified. Natural cause deaths include any death of a person because of a naturally occurring disease. Homicides include any death of a person at the hands of another. Self-inflicted deaths are any death of a person who has taken his or her own life

[10] The number of monthly RMDT depends on the average number of prisoners in the previous year. For an establishment with more than 400 inmates, 5% of the population must be tested, 10% with less than 400 inmates.

[11] No systematic effect of the law is detected on these RMDT tests.

[12] Assaults are also defined as 'serious' when one of the following injuries is sustained: a fracture, scald or burn, stabbing, crushing, extensive or multiple bruising, black eye, broken nose, lost or broken tooth, cuts requiring suturing, bites, temporary or permanent blindness.

irrespective of intent. This not only includes suicides but also accidental deaths because of the person's own actions.[13] Other non-natural deaths include any death that cannot easily be classified in any of the three previous categories after all the investigations have been concluded. Deaths for causes yet to be defined are recorded as 'unclassified'.

Self-Harm. These data are available at the establishment-by-month level from January 2004 to March 2018. Self-harm in prison custody is defined as 'any act where a prisoner deliberately harms themselves, irrespective of the method, intent or severity of any injury.' Neither this measure nor the outcome of self-harm incidents gives an indication of attempted suicide. Although incidents of self-harm may include attempts at suicide, it is difficult to determine intent with sufficient accuracy to be recorded as such.

Protesting Behaviour. These data are available at the establishment-by-month level from April 2000 to March 2018. They include the construction of barricades, where one or more offenders deny access to all or part of a prison to those lawfully empowered to have such access; concerted active (including aggression and violence) and passive indiscipline; hostage incidents, where one or more persons are held against their will, including hostage incidents where collusion was suspected or confirmed; and incidents at height, involving prisoners on the netting, climbing over bars or on the roof.

Miscellaneous of Other Data. To complement the analysis, I include several other pieces of information. The average number of prisoners and share of prisoners in crowded accommodations is available at the establishment-by-financial year level from 1996/97 to 2018/19. The number of prison officers is available at the establishment-by-quarter level from June 2013 to September 2017. I also retrieve the number of psychologists and chaplaincies in prison at one point in time, June 2016, the first period when this information is available. Lastly, I gather prisons characteristics such as whether the establishment is public or private, if it houses male or female prisoners, the prison's level of security, whether the prison is open, closed, or local (serving prisoners post-conviction before the allocation to other establishments). These data serve multiple purposes. I use them as controls for our robustness tests, as outcomes to explore possible mechanisms behind the findings, or as an extra layer of information for the heterogeneity analysis.

Sample Selection. I merge all the available information using the name of the establishment as the key-matching variable. As discussed, information comes from different spreadsheets with different starting and ending dates. For this reason, the sample starts in April 2007 and ends in March 2018. This is an 11-year window in which all the key variables about drug finds, RMDT, violence, and self-harm are always reported in the

[13] This classification is used because it is not always known whether a person intended to commit suicide.

data (but not in all prisons, see below). Within this window, we have 149 prisons for a total of 16,850 observations.

The initial panel data analysis exploring the impact of the NPS epidemic on various drug-related harms focuses on the 96 prisons that consistently reported information throughout the 132 months in our sample, for a total of 12,672 observations. Information for the remaining establishments is more sporadic due to prisons' entry and exit, as well as for lack of consistent reporting.[14] Focusing on a balanced panel of prisons minimizes measurement error and eliminates the concerns of our results being driven by a change in the structure of the panel or by sample attrition. In robustness checks, I show (similar) results when all available observations are used. Table I reports descriptive statistics.

After having documented the spreading of NPS in prison and the significant correlation with the rise in harm and violence behind bars, I study the impact of the PSA. This law was adopted late in the sample, in May 2016. For this reason, I centre the analysis around the month of PSA adoption, including 20 months preceding the law and 20 months with the law in operation. This choice allows us to obtain a balanced panel of prisons observed for the same length of time before and during the reform (96 prisons for 40 months for a total of 3,840 observations). In the robustness analysis, I show similar estimates when all prisons operating for at least some time during the relevant 40 months window are included, and when the window of analysis is extended.

4. Empirical Analysis

Motivating Evidence. Figure II shows the spreading of NPS in England and Wales prisons. The number of monthly NPS seizures displayed a fivefold increase, from around 160 in early 2012 to around 800 in March 2018. Seizures for other CDA remained relatively more stable throughout the period. The sole exception is cannabis whose seizures almost doubled in the last part of the sample. The bottom figure displays the change in the percentage of positive RMDT by type of substance. Data for NPS available from March 2017 confirm NPS represent by far the most used drug in prison, with around 12% of tests resulting positive compared to 5% for cannabis and lower for other substances. This evidence suggests the adoption of the PSA in May 2016 did not stop NPS distribution and usage in UK prisons.

Figure III plots the change in NPS seizures against the change in harm, violence, and deaths in prison over the period. The emerging correlation appears to be alarming. Changes in harm and violence seem to chase the steep rise in NPS seizures, following a nearly exponential growth starting around 2013. Figure A2 shows changes in the inmates to prisoners ratio, the number of prison officers, the percentage of prisoners in crowded accommodations, the total number of prisoners, and the public expenditures on UK prisons. More stable trends that do not resemble the steep rise in NPS, harm, and violence

[14] The reasons behind the lack of information for a certain prison-month is not readily available to the researcher.

are shown in Figure III. Overall, this evidence suggests the NPS epidemic may have had an important role in destabilizing prisons' environment.

Initial Panel Data Analysis. To shed more light on the impact of NPS availability on violence and harm within prison the following model is used:

$$y_{p,t} = \alpha_p + \delta_t + \beta NPS_{p,t-1} + \varepsilon_{p,t} \quad (1)$$

where $y_{p,t}$ is the outcome (e.g., the count of assaults) in prison *p* at time *t* (year-by-month level, e.g., September 2016). The variable of interest, $NPS_{p,t-1}$, is the count of NPS seizures at time *t-1* to partially avoid the problem of reverse causation. Prison fixed effects α_p absorb unobservable time-invariant differences across facilities. Year-by-month fixed effects δ_t control for uniform changes across all prisons, fitting a different intercept for each period in the sample. Standard errors are clustered two-way at the prison and year-by-month level to permit valid inference in the presence of both within-prison and within-period across-prisons autocorrelations in the errors. The coefficient of interest β measures the conditional correlation between the spreading of NPS and the corresponding outcome.

Importantly, equation (1) does not aim to identify any causal parameter; however, it is a necessary step toward documenting the dangers associated with the spreading of NPS inside prisons. Also, it lays the foundations for the subsequent analysis examining the causal impact of a government intervention restricting the supply of substances—that this study shows—are highly correlated with the rise in harm and violence behind bars.

Difference-in Differences: Single Coefficient Model. The challenge of identifying the effects of a national intervention separately from other policy and secular trends is addressed by exploiting cross-prison variation in the size of the NPS market pre-law. In essence, the PSA should have more 'bite' in prisons with an initially larger market for NPS. I estimate the following difference-in-differences equation:

$$y_{p,t} = \alpha_p + \delta_t + \beta_1\left(HINPST_{p,t=0} \times Post_t\right) + \varepsilon_{p,t} \quad (2)$$

Where *Post* is an indicator variable taking the value of 0 from September 2014 to April 2016 and 1 from May 2016 to December 2017; $\mathrm{HINPST}_{p,t=0}$ indicates high-intensity NPS trafficking prisons where NPS finds in the initial period are above the corresponding median. These prisons experience 9.1 monthly seizures compared to 3.1 in low-intensity NPS trafficking (LINPST) prisons. All other details are equal to estimating equation (1). The coefficient of interest β_1 identifies differences in the outcomes across prisons with initially larger and smaller NPS markets, testing for a trend break following the PSA implementation in May 2016.

Table IV displays descriptive statistics for 44 HINPST and 52 LINPST prisons. We show out-of-sample statistics from April 2007 to December 2011, as these are less likely to be affected by the steep rise in NPS availability that started in 2012.[15] HINPST prisons are characterized by a larger prevalence (finds per 1,000 prisoners) of NPS and of all other conventional drugs of abuse, and they also experience a higher percentage of positive RMDT. These prisons are relatively more populated and house a higher percentage of prisoners in crowded accommodations. This suggests drug markets proliferate where more customers are available, plausibly due to higher profitability, and in overcrowded establishments, where the probability of detection may be lower.[16] Less marked differences in harm and violence rates across establishments exist, suggesting determinants other than the prevalence of drugs markets can play a role in contributing to prisons disorders.

The definition of drug market size is based on the count of NPS finds pre-intervention, which is the most accurate measure retrieved from the available data. The robustness analysis shows similar results when using i) a continuous measure of the size of the market rather than the splitting at the sample median, ii) the share of NPS finds rather than the count, iii) finds in earlier periods, to demonstrate the choice of a particular pre-intervention month as a baseline is not driving our findings. These measures may also capture differences in detection rates across facilities that are difficult to quantify. Later in the paper, I discuss if, and in case how, pre-law differences can impact the validity of the empirical analysis and the interpretation of the findings.

Difference in Differences: Event Study Analysis. The next specification improves our understanding of the impact of the PSA in a variety of ways. First, it examines the presence of possible pre-trends potentially violating the main identifying assumption. Second, it explores the dynamics of the effects, showing whether responses emerge on 'impact' of the reform, and their persistence over time. Finally, it uncovers potential short-term effects that could be hidden in a single coefficient model averaging out all post-intervention estimates. To conduct this analysis, I estimate the following event-study equation:

$$y_{p,t} = \alpha_p + \delta_t + \sum_{\tau \in [-5,\,4],\, \tau \neq -1} \beta_\tau \left[HINPST_{p,t=0} \times \mathbb{I}(t \in \tau) \right] + \varepsilon_{p,t} \quad (3)$$

With τ being a four-month period and τ=0 being the period of implementation. The estimates of interest are the β_τ obtained interacting a dummy for the HINPST group to a dummy for each four-month period in the sample; β_τ estimates are relative to the pre-intervention period τ=-1 whose indicator variable is excluded from the analysis. All other details are equal to estimating equations (1) and (2).

[15] Descriptive statistics are similar when considering later pre-intervention periods in the sample.
[16] For a discussion about illegal markets formation and criminal activity see d'Este (2020) and Parey and Rasul (2021).

I estimate four-month periods rather than monthly dummies for two reasons. First, I want to maximize the power of the analysis as, in practice, this specification disaggregates the estimates of β_1 obtained from equation (2) in 9 estimates of beta, rather than 39, as would be the case with monthly dummies. Secondly, some of the outcomes are rare events the regression analysis fails to converge when attempting an event-study analysis of a fully saturated model with monthly event-study dummies.

Triple Differences Model. The last empirical exercise explores differential effects of the policy exploiting prison-specific (pre-intervention) characteristics as an additional source of information. We estimate the following difference-in-differences-in-differences model:

$$y_{p,t} = \alpha_p + \delta_t + \beta_1\left(HINPST_{p,t=0} \times Post_t\right) + \beta_2\left(HINPST_{p,t=0} \times Post_t \times \zeta_p\right) + \beta_3\left(\zeta_p \times Post_t\right) + \varepsilon_{p,t} \quad (4)$$

Where ζ_p is an indicator for a prison characteristic (e.g., 'male' prison, or prison with above-median officers to prisoners ratio). All other details are equal to estimating equations (1) and (2). In this model, β_2 tests for significant differences in the impact of the law in HINPST prisons with a certain characteristic ζ_p, while the sum of β_1 and β_2 captures the differential impact of the policy in these prisons. This specification attempts to locate establishments experiencing a relatively larger impact of the policy and to shed some further light on the possible mechanisms behind the effects.

Identification Threats. First, one may be worried the discussed pre-intervention differences between HINPST and LINPST prisons could play a major role in determining different outcomes after the law. The internal validity of the exercise is unlikely to be affected by such differences given that prison fixed effects absorb possible time-invariant confounders. Also, the analysis shows effects emerging on the 'impact' of the reform, minimizing concerns the results are driven by historical differential trends across prisons.

Second, the findings hinge on the hypothesis that HINPST and LINPST prisons would have displayed similar patterns in the absence of the law, conditional on a set of fixed effects and observable characteristics. The event-study analysis corroborates this hypothesis, showing the absence of significant 'pre-trends' in the main outcomes of the analysis, further validating the results of the work.

Third, in an ideal experiment, one would want to study the behaviour of the same population before and after the treatment, in both treated and control groups. However, a relatively larger number of convicts may have entered HINPST prisons in response to the PSA, potentially confounding the interpretation of the findings. In fact, the entry of new inmates could destabilize the prison environment, increasing the prisoners to officers ratio, and worsening inmates' living conditions. These dynamics, rather than the shock to NPS supply, may explain the increase in violence and self-harm.

As of December 2017, only 68 convicts were imprisoned due to the PSA out of a total prison population of around 60,000 inmates. This seems a trivial addition to explaining the effects detected in the analysis. Also, the difference-in-differences strategy will reveal no signs of a significant (or large) differential increase in the number of prisoners, the officers to prisoners ratio, and the share of prisoners in crowded accommodations in HINPST prisons. This further reduces the concerns the entry of new inmates caused by the implementation of the reform is a key driver of the findings.[17]

Lastly, data including variables measuring drug availability, drug usage, and violence inside prisons will suffer from some form of measurement error. Classical measurement error in the outcome variable will affect the precision of the estimates, inflating confidence intervals. If anything, this makes it more difficult to detect significant estimates. A more problematic form of measurement error could emerge if the error was systematically correlated with the timing of the PSA in HINPST prisons. For instance, such prisons may have started to record more accurate information right after the law was implemented. Importantly, the analysis shows a *reduction* in NPS finds and an *increase* in harm and violence due to the laws in HINPST prisons. Hence, measurement error should be systematically negative for NPS seizures and positive for the other outcomes to bias the analysis. This appears to be a remote possibility.

5. Results

To allow for an organised reading of the results, tables showing estimates from panel data analysis, difference-in-differences single-coefficient model, and event study analysis are assembled as follows. Column 1 displays the baseline for the corresponding estimation equation. Column 2 includes the number of prisoners and the percentage of prisoners in crowded accommodations as a control. Column 3 incorporates prison-by-month fixed effects to capture possible seasonality in the data. Column 4 adds prison-specific linear annual trends to absorb potential unobservable confounding factors correlated with the implementation of the law. Column 5 shows results from the weighted least squares (WLS) estimator, using the average annual population of prisoners as a weight. Column 6 shows standard errors clustered at the prison level, to allow for within-prison serial correlation in the errors only. Column 7 displays log-log and log-linear estimates in the panel data and in the difference-in-difference analysis, respectively; column 8 shows results obtained from a negative binomial count data regression. The latter specifications test the robustness of our findings to changes in the functional forms used for the analysis.

[17] One may also worry other programs could have been adopted alongside the PSA, differentially affecting prisons with different characteristics. While we can't account for all the prisons-specific programs adopted after the PSA in each establishment, close consultations of UK policy measures and discussions with the Ministry of Justice indicate no major intervention took place in the 20 months following the reform.

Initial Analysis. Estimates of equation (1) are presented in Table II. This table shows the conditional correlations between NPS finds and serious assaults, deaths, self-inflicted deaths, and self-harm. Positive and significant estimates are detected across the board. These conditional correlations have realistic magnitudes. Elasticities computed in the log-log specifications are small for homicides and self-inflicted deaths, whilst they range from 7% to 14% for serious assaults and self-harm, respectively. Estimates appear to be robust across most specifications; the inclusion of prison-specific linear trends reduces the size of the effects that are still positive and significant for all outcomes but deaths. Such trends attempt to absorb unobservable annual patterns associated with the passage of the reform and with the proliferation of harm and violence within a prison; however, these could also absorb genuine correlation, producing overfitting, leading to conservative and imprecise estimates (Buonanno et al. 2011).

Drug seizures are the best proxy for drug accessibility that is available to researchers. However, enforcement effort to detect drugs is plausibly correlated with determinants of violence and self-harm within prisons, thus potentially confounding the interpretation of the results. To reduce the extent of this concern, Table III shows conditional correlations for NPS and other main CDA: cannabis, cocaine, heroin, and amphetamine. Given that all explanatory variables are seizures, this analysis explores the specific role of NPS in contributing to violence by comparing estimates across different drug finds. To allow for a meaningful comparison, outcomes and explanatory variables are standardised to have a mean of zero, and a standard deviation of one.

The estimates suggest that one standard deviation increase in NPS availability is associated with a .23 standard deviation increase in aggravated assaults, a .095 increase in deaths, and around 0.04 standard deviation increase in self-inflicted deaths and self-harm. Estimates of the NPS impacts survive the inclusion of other CDA. Also, the estimates for other CDA do not display patterns similar to those observed for NPS, confirming the strong association between the spreading of NPS and the proliferation of harm and violence within prison.

The Impact of the PSA on NPS Availability. Table V reports the estimates of the impact of the PSA on NPS availability in prison obtained using estimating equation (2). The outcome of the analysis is the count of NPS finds. Negative and significant estimates are detected across all specifications. Considering a pre-intervention mean of around 5.4 seizures a month per prison, the baseline estimate displayed in column (1) suggests HINPST prisons experienced a reduction of around 28% in the number of NPS finds, which is consistent with the result of a log-linear specification displayed in column (7). Table A1 also shows robustness tests to alternative classifications of NPS, with results similar to the baseline.

One may now wonder: What do changes in NPS seizures tell us about the impact on NPS availability we are after? The ideal data to answer this question would be a census of all available new psychoactive substances in prison before and after the laws went into

effect. These records do not exist. The count of NPS finds is an unknown fraction of the total quantity of NPS available, but it also depends on the probability of detection (a function of the efforts of law enforcement agents, reports from prisoners, available detection technologies, and other random factors). If the probability of detection did not change differentially across prisons after the passage of the law, then the percentage change in NPS seizures is an unbiased estimate of the change in NPS availability. One could argue the PSA may have increased prison officers' efforts to intercept NPS, particularly in prisons where NPS are commonly trafficked. If so, the fall in NPS seizures is likely to understate the true reduction in NPS availability in HINPST prisons.[18]

Figure V further investigates the reliability of these findings by showing trends in the raw data for HINPST and LINPST prisons and event study estimates of τ obtained via equation (3). The evidence shows the absence of significant differences in trends between groups before the implementation of the policy, providing further validation to the internal validity of the exercise. The analysis also reveals effects lasting until the end of the sample, suggesting the PSA has produced a long-lasting but partial reduction in NPS availability in HINPST prisons. Table A4 shows event study robustness tests, showing similar estimates to the baseline in terms of size and precision across specifications.

Considering the size of the estimates, the length of the effects, the number of NPS finds pre-intervention in high-prevalence prisons, and the average of 5 grams per NPS find before the policy was implemented, a back of the envelope calculation suggests the policy has reduced NPS availability by around 11 kilograms, or around 220,000 drug doses, with a value of more than £1 million.

Supply-Side Interventions and Substitution Effects. The scope of the PSA may have been limited by two possible substitution responses originating from producers and consumers. First, the crackdown on NPS may have affected criminals operations, incentivizing the trafficking of other illicit substances inside prisons. Secondly, one may also observe substitution responses emerging from the demand side of the market. By increasing prices (Grey and Ralphs 2017; Home Office 2018) and the cost of NPS usage, the reform may have led existing consumers to substitute other conventional drugs of abuse. The size of these responses will likely depend on cross-price elasticities of demand as well the availability of other addictive substances (Alpert et al. 2018). Such responses have been identified in the economic literature showing fluid substitution for alcohol, smoking, and marijuana (e.g., Pacula 1998; Powell et al. 2018).

Single coefficient estimates about the impact of the PSA on the number of seizures and positive RMDT for cannabis, opioids, cocaine, and amphetamines are shown in Table A2. Event study results are reported in Figure VI (A-B). Estimates from the single-coefficient models are inconclusive, at the very least denoting the absence of a sizable or sustained substitution towards other CDA. Event study estimates unveil responses hidden in the last

[18] A similar argument is used by Dobkin et al. (2014) when studying the impact of US laws restricting the access to pseudoephedrine-based medications on methamphetamine labs seizures.

periods of the sample for cannabis and cocaine seizures, and positive RMDT for cannabis. Cannabis and cocaine represent the natural substitutes for 'spice' (synthetic cannabinoid) and 'bath salts' (synthetic cathinone) the most prevalent NPS in UK prisons. Event study robustness checks for these three outcomes are reported in Tables A5 to A7. Overall, estimates reveal some sign of a possible substitution originating from both sides of the market happening late in the sample period. This suggests the long-lasting impact of the law on the supply and availability of NPS has generated substitution responses with some delay, presumably because of the time needed by criminal organizations to increase the supply of other illicit substances in prisons.

Supply-Side Interventions and Violence. The preceding analysis has shown the PSA has brought a significant, sustained, but partial reduction in NPS availability, with some evidence of possible substitution effects emerging late in the sample period. The potential impact of the policy on violence inside a jail is not clear *ex-ante*.

NPS scarcity induced by the PSA is likely to increase drug prices. While official data on NPS prices before after the reform do not exist, numerous qualitative evidence suggests the law led to an 80% to 300% price increase (Ralphs et al. 2017; Shapiro and Daily 2017; Home Office 2018). Coupled with the inelastic demand for highly addictive substances, the increase in prices is likely to have increased the profitability of the drug trade, affecting the offenders' expected utility of using systemic violence to operate in the drug market, solving disputes over drugs, taking over new market shares, and defending own market shares (Goldstein, 1985).

The impact of the law on NPS usage cannot be studied due to data limitations. However, one may think the reduction in NPS availability and the increase in prices induced by the PSA have reduced NPS consumption. A decrease in usage of a stimulating addictive substance can impact psychotic violent behaviour in two opposite ways. On the one hand, it can reduce violence arising while 'under the influence'; on the other hand, it can increase erratic and violent behaviour due to withdrawal symptoms or the fear of experiencing its heavy effects.

Estimates from the single coefficient model displayed in table A3 display a positive but insignificant impact on serious assault among prisoners and deaths. Event study estimates displayed in Figure VII, reveal an increase in serious assaults among prisoners emerging right after the implementation and between 12 to 16 months after the policy. We also observe an increase in non-natural deaths visible in periods 1, 2, and 4. For both outcomes, pre-law estimates do not reveal significant differences across the two groups of prisons, indicating that the differential impact of the policy on violence in HINST prisons is genuine. The estimates, likely capturing the net impact of the policy arising from the systemic and psychotic channels discusses above, suggest the policy has generated around 232 serious assaults and 10 non-natural deaths.

NPS, Supply-Side Interventions, and Self-Harm. The rising usage of NPS has become a significant medical concern, causing growing challenges for clinicians working in both mental health and emergency departments. Suicidality and self-harm are frequently associated with the abuse of the most used NPS such as cathinone, synthetic cannabinoids, and synthetic opioids (Chiappini et al. 2021). The work of Borgschulte et al. (2018) provides a useful benchmark to understand how a supply-side intervention affecting the market for illegal drugs can impact self-injurious behaviour.

The reduction in NPS supply and availability identified in this analysis, and the probable increase in prices suggested by various qualitative studies, have likely affected NPS usage, making it more difficult for habitual consumers to maintain a regular drug intake. This has also reduced the value of drug use, as heavy withdrawal symptoms may have been alleviated less frequently. On the one hand, this may have increased the incentives to exert effort for recovery, especially among users with less severe forms of addictions and who may have had access to the help of doctors and psychologists, leading to a reduction in self-harm and suicides. On the other hand, the PSA may have led drug habits to become unsustainable for individuals suffering from severe addiction and mental health problems, leading to undesired outcomes

Table A3 displays the single coefficient estimates of the impact of the PSA on these two outcomes. Estimates are positive across the boards for both self-harm and self-inflicted deaths but are not significantly different from zero. The event study analysis allows for a more in-depth look at the dynamics of the impact. Figure VII shows a significant effect limited to the four months after the implementation, attenuating in the subsequent periods. The event study indicates no sign of pre-existing trends, providing further reassurance regarding the validity of the results, which also survive most robustness checks presented in Tables A9 and A10. This analysis suggests a short-term and significant impact of the PSA on NPS consumers, leading to around 725 episodes of self-harm and 8 self-inflicted deaths. The dynamics of the effects suggest users were able to adjust after being hit by the PSA, presumably due to a mix of gradual adaption to the reduced availability of NPS and the substitution to other illegal substances discussed above.

Alternative Channels. There may be other competing explanations behind the rise in violence and self-harm identified in the analysis. One may think that many convicts entered the HINPST establishments due to the crackdown on NPS, destabilizing the prisons environment, increasing the prisoners to officers ratio, and worsening inmates' living conditions. As of December 2017, the last month in the sample, only 68 convicts were imprisoned due to the PSA in England and Wales out of a total prison population of around 60,000 inmates. This suggests the entry of such a small number of inmates is unlikely to explain the rise in violence and self-harm detected in this work. Also, Figure VIII shows no evidence of a significant or large increase in prisoners or worsening of the prisons' conditions. This analysis exploits financial-year level information on the number of prisoners and the percentage of prisoners in crowded accommodation, and quarterly

level data on the number of prison officers. Therefore, it is less precise than the main analysis in which outcomes are measured monthly. However, all the evidence provided suggests the discussed channels are unlikely to be behind the rise in violence and self-harm.

Another possible channel is related to the increase in sentences brought by the PSA. This change is not retroactive and cannot directly impact prisoners already sentenced for NPS-related reasons. However, new penalties may have affected individuals already in prison, punishing consumption behind bars with sentences of up to 1 year, and trafficking with sentences of up to six years. This may have led to an increase in violence out of anger, and self-harm out of despair, especially in prisons where NPS are heavily trafficked and consumed. These hypotheses cannot be entirely ruled out, as the exact motivations leading to each episode of violence and self-harm are not available to the researcher. However, Figure VIII shows no significant or large effects of the PSA on serious assaults against staff and protests in jail. If anger or despair due to the new sentences' guidelines were key drivers of the effects, we should have probably expected to observe an increase in violence against the establishment or a rise in prisoners' protests.

Heterogeneity Analysis. The final section attempts to explore the potential heterogeneous impacts of the policy exploiting pre-law and time-invariant prison characteristics. This analysis aims to locate establishments experiencing a relatively larger impact of the policy and shed some further light on the possible mechanisms behind the effects identified in this study. Results from equation (4) are displayed in Table VI, which reports the PSA impact on the outcomes most significantly affected by the policy: NPS finds, serious assaults on prisoners, non-natural deaths, self-harm, and self-inflicted deaths.

The analysis suggests the PSA has reduced NPS availability more in male HINPST establishments, exacerbating the unwarranted impacts on non-natural deaths, self-harm, and suicides. Other estimates are not always precise and of more difficult interpretation. With this caveat in mind, results suggest the PSA had a larger impact on violence in more densely populated prisons, with an above-median inmate per officer ratio. The impact on self-harm appears to be larger in overcrowded and densely populated prisons, and in establishments with lower access to psychologists, who may be helpful for prisoners suffering from NPS addiction and withdrawal symptoms. Estimates on self-inflicted deaths follow an opposite direction but are of even more difficult interpretation, plausibly because of the sparsity of the outcome.

6. Concluding Remarks

This paper examines the impact of new psychoactive substances, powerful and highly addictive chemical compounds that mimic the pharmacological effects of conventional drugs of abuse but avoid classification as illegal and detection in standard drug tests. We focus our attention on the prison system; while incarceration is a crucial part of the

scholarly analysis of crime, what happens inside penal institutions largely remains a 'black box' (Western 2021). To conduct the analysis, I have assembled a novel establishment-by-month database of all England and Wales prisons from March 2007 to April 2018 including information on drugs seizures, drug test results, various measures of harm, violence, causes of death, and other prison characteristics.

The analysis documents a large increase in NPS availability and a startling correlation with the steep rise in harm and violence behind bars. This conditional correlation survives a large battery of robustness checks, and it is specific to NPS, while it is less pervasive for other mainstream drugs of abuse such as cannabis, heroin, cocaine, and amphetamine. I then evaluate the impact of the Psychoactive Substances Act 2016, a supply-side intervention that imposed a total ban on the open sale of NPS in the United Kingdom to stop new drugs from appearing on the market due to small differences in the chemical make-up bypassing the outdated legislation.

The challenge of identifying the effects of a national intervention separately from other policy and secular trends is addressed by exploiting cross-prison variation in the size of the NPS market pre-law. I argue the PSA should have stronger effects in prisons with an initially larger market for NPS.[19] The analysis shows that, in response to the law, high-intensity NPS trafficking prisons experienced a sustained but partial reduction in NPS availability of around 28%, a limited increase in the supply and demand of cannabis and cocaine, and a violent upsurge of around 232 aggravated assaults, 725 episodes of self-harm, and 18 self-inflicted and non-natural deaths.

The findings have important implications for violence perpetrators, victims, the prison population, and society. Inmates committing violent acts as a response to the policy are more likely to experience new criminal sentences and delayed releases (Mukherjee and Sanders 2021). Also, Chen and Shapiro (2007) and Lotti (2020) show harsher prison conditions, such as the one likely arising due to the increase in violence and self-harm detected in our study, can increase reoffending rates. This implies the social costs of the PSA 2016—already comprising the increase in violence and self-harms detected in our study—will likely include more crime on the streets and longer and repeated prison sentences in the future.

The role of science and technology is of fundamental importance to prevent the spreading of these new dangerous substances. Researchers are now training computers to predict the next NPS even before these enter the market (Skinnider et al. 2021). Identifying the so-called 'legal highs' from seized pills can take months, and this new line of research could help law enforcement agencies around the world reduce the time needed for identification from months to days, therefore speeding up the race of identifying and regulating new substances emerging from the illicit market.

Also, health and social programmes focused on helping and rehabilitating drug addicts may attenuate the emergence of violent responses to laws restring access to addictive

[19] Other examples of UK policies leading to unwarranted effects include Fetzer (2019) and d'Este (2021).

substances. This is in line with the Ten-Year Drug Strategy and the 21st Century Cures Act, two recent measures implemented by the UK and the US government, which will provide £780 billion and $1 billion in funding for demand-side interventions (such as prevention and substance abuse treatment) to reduce the prevalence of drug addiction (Alpert et al. 2018).

Collectively, this paper's findings suggest new challenges stemming from scientific advances in illegal drugs production should not be addressed through old-fashioned supply-side measures alone, but through systemic interventions that combine scientifically advanced measures attempting to limit the expansion of the NPS market, with demand-side interventions focusing on high-risk environments where drug use and violence are common.

Whist NPS account for a small share of total drug-related harm in the UK and across the globe, they represent a collective threat for two important reasons (Reuter and Pardo 2017). First, scientific progress and constant research of powerful and addictive substances can lead to successful results, generating new drugs that may have a combination of characteristics such as those that made cocaine and heroin a global public threat. Secondly, some NPS could turn out to be a very dangerous failure, thus harming the health of users. This was the case with the Jamaica Ginger during the US alcohol prohibition when around 35,000 users experienced long-term paralysis by consuming a variant of alcohol mixed with numerous chemical substances. More recently, the 'zombie epidemic' was observed in New York City, where a synthetic cannabinoid caused mass intoxication, in an event described in the popular press as a 'zombie' outbreak because of the appearance of the intoxicated persons (Adams et al. 2017).

Finally, this study provides timely policy implications and informs policymakers outside the UK about possible drawbacks of regulations legitimately attempting to disrupt NPS supply. In fact, the US, Eastern Europe, Southeast Asia, and Australia are all experiencing a rise in the number of available NPS facing the negative consequences associated with the propagation of these new dangerous drugs (UNODC 2021).

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Table I
Descriptive Statistics

	Obs.	Mean	Std. Dev.	Min	Max
Drugs Seizures					
NPS	12,672	3.108	5.464	0	63
Cannabis	12,672	1.041	2.268	0	38
Cocaine	12,672	.097	.42	0	9
Heroin	12,672	.239	.679	0	11
Amphetamine	12,672	.046	.237	0	3
Positive Drug Tests (%)					
Cannabis	12,672	3.452	4.867	0	50
Cocaine	12,672	.228	.926	0	16.667
Opiates	12,672	2.123	3.049	0	29.032
Amphetamine	12,672	.061	.47	0	11.111
Positive Drug Tests (#)					
Cannabis	12,672	1.425	2.30	0	34
Cocaine	12,672	.0858	.329	0	5
Opiates	12,672	.881	1.33	0	16
Amphetamine	12,672	.022	.159	0	3
Drug-Related Harms					
Serious Assault on Staff	12,672	.248	.595	0	7
Serious Assault on Prisoners	12,672	1.062	1.672	0	20
Indiscipline	12,672	.12	.424	0	8
Self-Inflicted Deaths	12,672	.054	.235	0	2
Self-Harms	12,672	19.253	26.718	0	396
Homicides	12,672	.0018	.0425	0	1
Non-Natural Deaths	12,672	.0071	.0867	0	3
Unclassified Deaths	12,672	.0012	.0343	0	1
Number of Prisoners	12,516	694.436	316.548	87	1725
% In Crowded Accommodations	12,444	20.994	25.202	0	93.7

Notes: This table shows descriptive statistics for the balanced sample of 96 UK prisons from April 2007 to March 2018 (96 prisons × 132 months=12,672 observations). The lower number of observations for the number of prisoners and the percentage of prisoners in crowded accommodations is due to missing observations in the data. The number of prisoners and the percentage of prisoners in crowded accommodation are recorded by financial year. All other information is recorded monthly.

Table II
NPS and Drug-Related Harms in Prisons

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Baseline	Baseline +Controls	Baseline +Prison-by-Month FE	Baseline +Prison Trend	Baseline Weighted	SE clustered at the Prison Level	Log-Log Regression	Negative Binomial Regression
				Serious Assaults				
NPS	0.0833***	0.0813***	0.0866***	0.0340***	0.0858***	0.0833***	0.0770***	0.0114***
	(0.0157)	(0.0146)	(0.0164)	(0.0122)	(0.0185)	(0.0153)	(0.0143)	(0.00343)
				Deaths				
NPS	0.000853**	0.000859**	0.000836**	0.000574	0.000889*	0.000853**	0.00342***	0.0155
	(0.000417)	(0.000416)	(0.000387)	(0.000549)	(0.000500)	(0.000357)	(0.000973)	(0.0214)
				Self-Inflicted Deaths				
NPS	0.00163***	0.00161***	0.00162**	0.00187**	0.00148**	0.00163**	0.00750***	0.0154
	(0.000585)	(0.000559)	(0.000659)	(0.000862)	(0.000653)	(0.000681)	(0.00205)	(0.0113)
				Self-Harm				
NPS	0.858***	0.826***	0.883***	0.355***	0.887***	0.858***	0.144***	0.0189***
	(0.158)	(0.139)	(0.161)	(0.111)	(0.204)	(0.156)	(0.0221)	(0.00413)
Obs.	12,576	12,339	12,576	12,576	12,423	12,576	12,576	12,576

Notes: This table shows estimates of the correlation between NPS seizures and various drug-related harms displayed in each panel title. Deaths include homicides, non-natural deaths, unclassified deaths. All regressions include prison fixed effects and year-by-month fixed effects. Unless otherwise noted, standard errors displayed in parenthesis are clustered two-way at the prison and year-by-month level. Column 1 shows the baseline. Column 2 includes the number of prisoners and the percentage of prisoners in crowded accommodations. Column 3 includes prison-by-month fixed effects. Column 4 includes prison-specific linear annual trends. Column 5 weights the regression using the number of prisoners as a weight. Column 6 shows standard errors clustered at the prison level. Column 7 displays estimates obtained from a regression where dependent (y) and independent variables (x) are expressed as log(1+y) and log(1+x), respectively. Column 8 shows results from a negative binomial count data regression. *** significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Table III
NPS, Other Illegal Drugs, and Drug-Related Harms in Prisons (Standardized Variables)

	(1)	(2)	(3)	(4)
	Serious Assaults	Deaths	Self-Inflicted Deaths	Self-Harm
NPS	0.230***	0.0953**	0.0433*	0.0398***
	(0.0442)	(0.0422)	(0.0219)	(0.0143)
Cannabis	0.0446***	0.0659**	0.0105	-0.0183
	(0.0155)	(0.0255)	(0.0115)	(0.0123)
Cocaine	0.00419	-0.0139	-0.00133	-0.00554
	(0.0143)	(0.00951)	(0.0131)	(0.0107)
Heroin	-0.0415***	-0.0238**	-0.0150*	0.00912
	(0.0146)	(0.00946)	(0.00794)	(0.0123)
Amphetamine	-0.00105	0.00261	0.00685	-0.00529
	(0.00760)	(0.0151)	(0.0103)	(0.00823)
Obs.	12,576	12,576	12,576	12,576

Notes: This table shows estimates of the correlation between drugs' seizures (by type of drug) and various drug-related harms displayed in each column title. Deaths include homicides, non-natural deaths, unclassified deaths. Outcomes and explanatory variables are standardized to have a mean 0 and standard deviation of 1. Each column shows the results of a separate regression including prison fixed effects and year-by-month fixed effects. Standard errors displayed in parenthesis are clustered two-way at the prison and year-by-month level. *** significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Table IV
Descriptive Statistics for LINPST and HINPST Prisons Prior to the Start of the NPS Epidemic

	(1)	(2)
	LINPST	HINPST
Number of Prisoners	597.244	780.465
% Crowded Accommodations	15.524	27.026
Harm and Violence per 1,000 Inmates		
Serious Assault (Staff)	.269	.209
Serious Assault (Prisoner)	.983	1.151
Indiscipline	.155	.075
Deaths	0.00694	.00872
Self-Inflicted Deaths	.06513	.06534
Self-Harms	41.552	21.612
Drugs' Prevalence (Finds per 1,000 Inmates)		
NPS	1.271	3.402
Cannabis	.74	2.096
Cocaine	.06	.239
Heroin	.248	.883
Amphetamine	.047	.139
Positive Drug Tests (%)		
Cannabis	3.158	3.724
Cocaine	.15	.179
Opiates	2.341	3.186
Amphetamine	.033	.044

Notes: The sample includes means for 96 prisons, 52 in the low-intensity NPS trafficking (LINPST) group (2,868 observations), 44 in the high-intensity NPS trafficking (HINPST) group (2,451 observations) from April 2007 to December 2011. We compute statistics before 2012 because these are less likely to be affected by the steep rise of NPS availability that started after 2012 (see Figure I). Variables included in the drug seizures and in the harm and violence panels are standardized per 1,000 prisoners to allow for a meaningful comparison. Deaths include homicides, non-natural deaths, and unclassified deaths.

Table V
The Impact of the Psychoactive Substances Act 2016 on Prisons' NPS Seizures

	(1) Baseline	(2) +Controls	(3) +Prison-by-Month FE	(4) +Prison Trend	(5) Weighted	(6) SE clustered at the Prison Level	(7) Log-Lin Regression	(8) Negative Binomial Regression
	NPS Seizures							
Post × HINPST	-1.478**	-1.425**	-1.449*	-1.353**	-1.657*	-1.478**	-0.288***	-0.480***
	(0.727)	(0.714)	(0.744)	(0.639)	(0.919)	(0.741)	(0.0867)	(0.138)
Observations	3,840	3,840	3,840	3,840	3,840	3,840	3,840	3,840

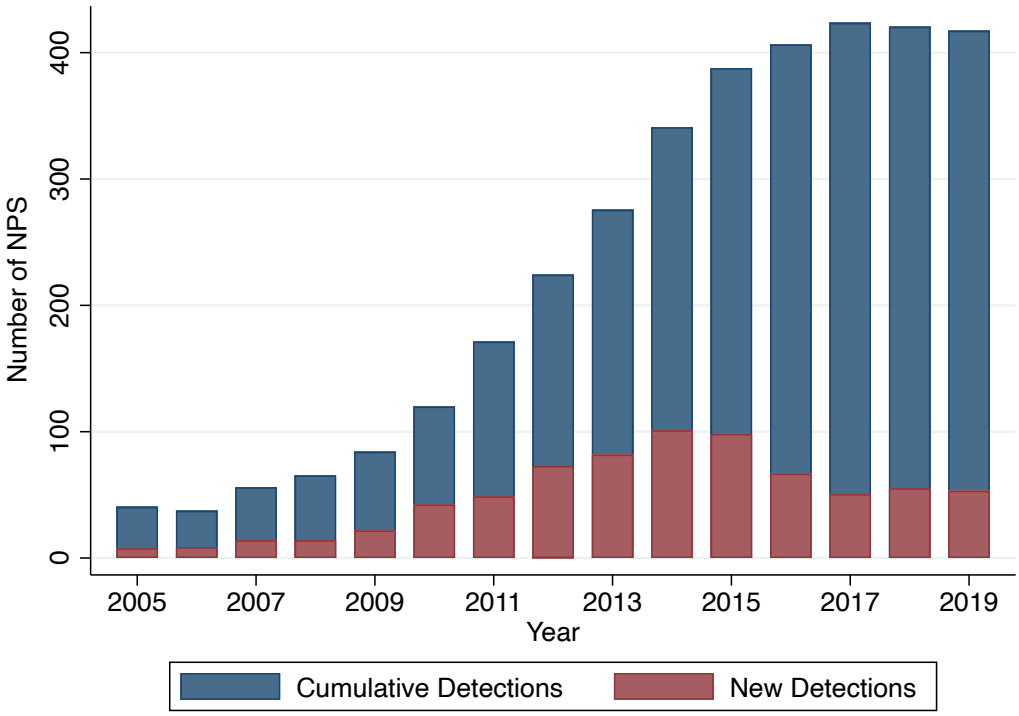
Notes: This table shows estimates of the impact of the Psychoactive Substances Act 2016 on NPS seizures. 'Post' is an indicator variable taking the value of one in May 2016 and afterwards; zero otherwise. 'HINPST' is an indicator variable taking the value of one if the number of NPS seizures 20 months prior to the implementation of the Act is above the corresponding median; zero otherwise. The sample includes 96 prisons for 40 months, 20 before and 20 after the act (96×40=3,840 observations). All regressions include prison fixed effects and year-by-month fixed effects. Unless otherwise noted, standard errors displayed in parenthesis are clustered two-way at the prison and year-by-month level. Column 1 shows the baseline. Column 2 includes the number of prisoners and the percentage of prisoners in crowded accommodations. Column 3 includes prison-by-month fixed effects. Column 4 includes prison-specific linear annual trends. Column 5 weights the regression using the number of prisoners as a weight. Column 6 shows standard errors clustered at the prison level. Column 7 displays the estimate obtained from a regression where the dependent variable (y) is expressed as log(1+y). Column 8 shows results from a negative binomial count data regression. *** significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Table VI
Heterogeneity Analysis

Male Prisons	(1) NPS Seizures	(2) Assault on Prisoners	(3) Non-Natural Death	(4) Self-Harm	(5) Self-Death
Post×HINPST	-0.985	0.450***	-0.00500	-52.37***	-0.0600***
	(0.730)	(0.0896)	(0.00797)	(4.522)	(0.0122)
Post× HINPST ×Characteristic	-0.630	-0.268	0.0167*	56.64***	0.0824***
	(1.008)	(0.242)	(0.00943)	(5.320)	(0.0216)
Overcrowding					
Post×HINPST	-0.526	0.198	0.0114	-2.815	0.00143
	(0.847)	(0.183)	(0.00777)	(3.873)	(0.00878)
Post× HINPST ×Characteristic	-1.849	0.0209	-0.00101	8.292*	0.0277
	(1.436)	(0.448)	(0.0128)	(4.844)	(0.0266)
Inmates Per Officer					
Post×HINPST	-1.441	-0.221	-0.00357	0.807	0.0571***
	(0.888)	(0.249)	(0.00763)	(3.777)	(0.0153)
Post× HINPST ×Characteristic	0.394	0.343	0.0281**	2.693	-0.0648**
	(1.284)	(0.450)	(0.0131)	(4.535)	(0.0270)
Inmates Per Psychologist					
Post×HINPST	-1.112	-0.0952	0.00429	1.002	0.0386
	(0.784)	(0.195)	(0.00876)	(2.779)	(0.0265)
Post× HINPST ×Characteristic	-0.302	-0.0234	0.0182	1.103	-0.0405
	(1.387)	(0.465)	(0.0149)	(4.620)	(0.0414)

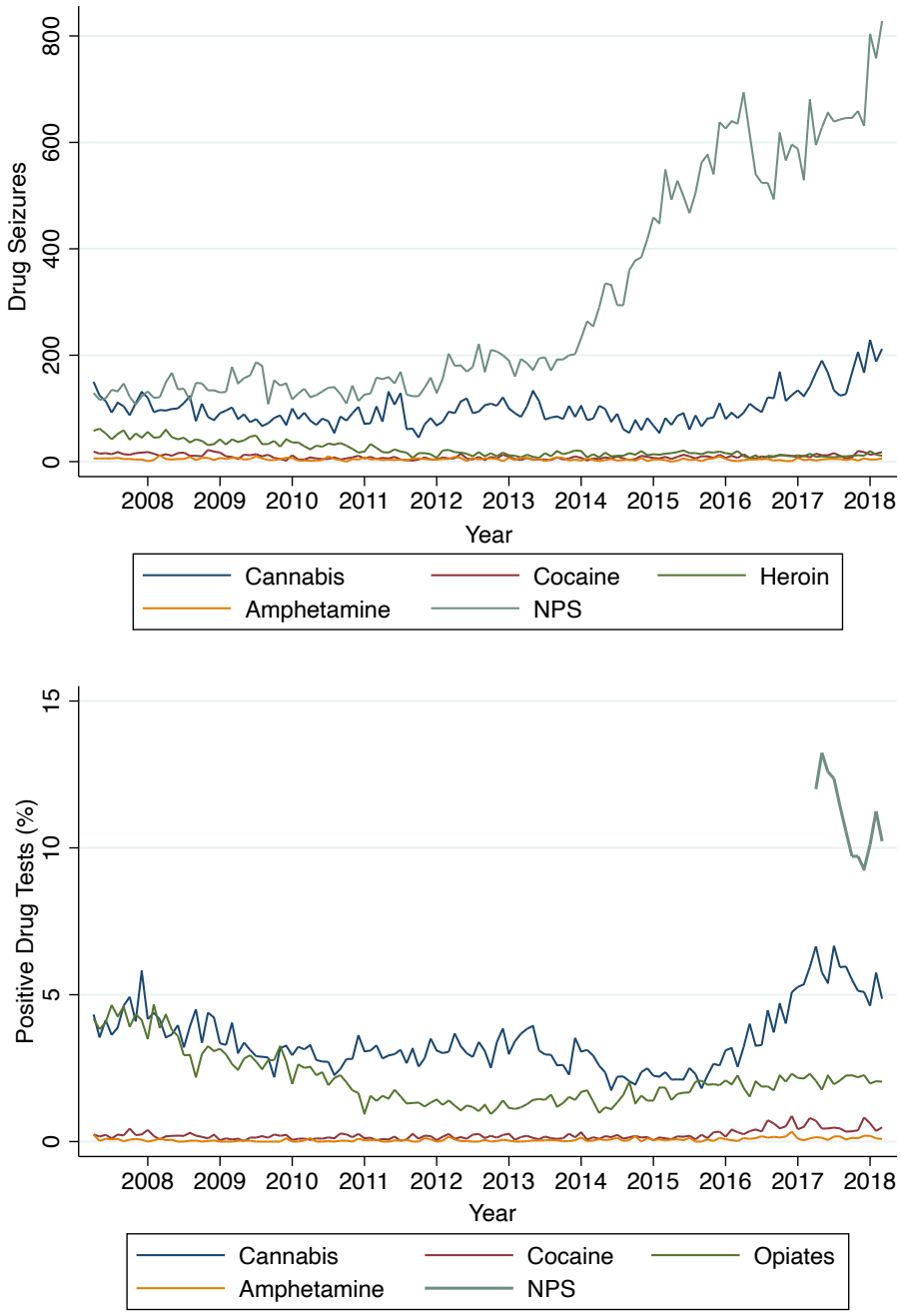
Notes: This table shows estimates of heterogeneity in the impact of the Psychoactive Substances Act 2016 on drug-related harms (displayed in column titles). 'Post' is an indicator variable taking the value of one in May 2016 and afterwards; zero otherwise. 'HINPST' is an indicator variable taking the value of one if the number of NPS seizures 20 months prior to the implementation of the Act is above the corresponding median; zero otherwise. 'Characteristic' is a dummy variable indicating whether a prison belongs to the corresponding group displayed in the panel title (e.g., "male prison"). For 'overcrowding', 'inmates per officer', and 'inmates per psychologist' the dummy refers to whether the characteristic measured 20 months prior to the implementation of the Act is above the corresponding median. The sample includes 96 prisons measured for 40 months, 20 before and 20 after the act (96×40=3,840 observations). All regressions include prison fixed effects, year-by-month fixed effects, and Post×Charactersitic. Unless otherwise noted, standard errors displayed in parenthesis are clustered two-way at the prison and year-by-month level. Column 1 shows the baseline. Column 2 includes the number of prisoners and the percentage of prisoners in crowded accommodations. Column 3 includes prison-by-month fixed effects. Column 4 includes prison-specific linear annual trends. Column 5 weights the regression using the number of prisoners as a weight. Column 6 shows standard errors clustered at the prison level. Column 7 displays the estimate obtained from a regression where the dependent variable (y) is expressed as log(1+y). Column 8 shows results from a negative binomial count data regression. *** significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Figure I
Detection of New NPS



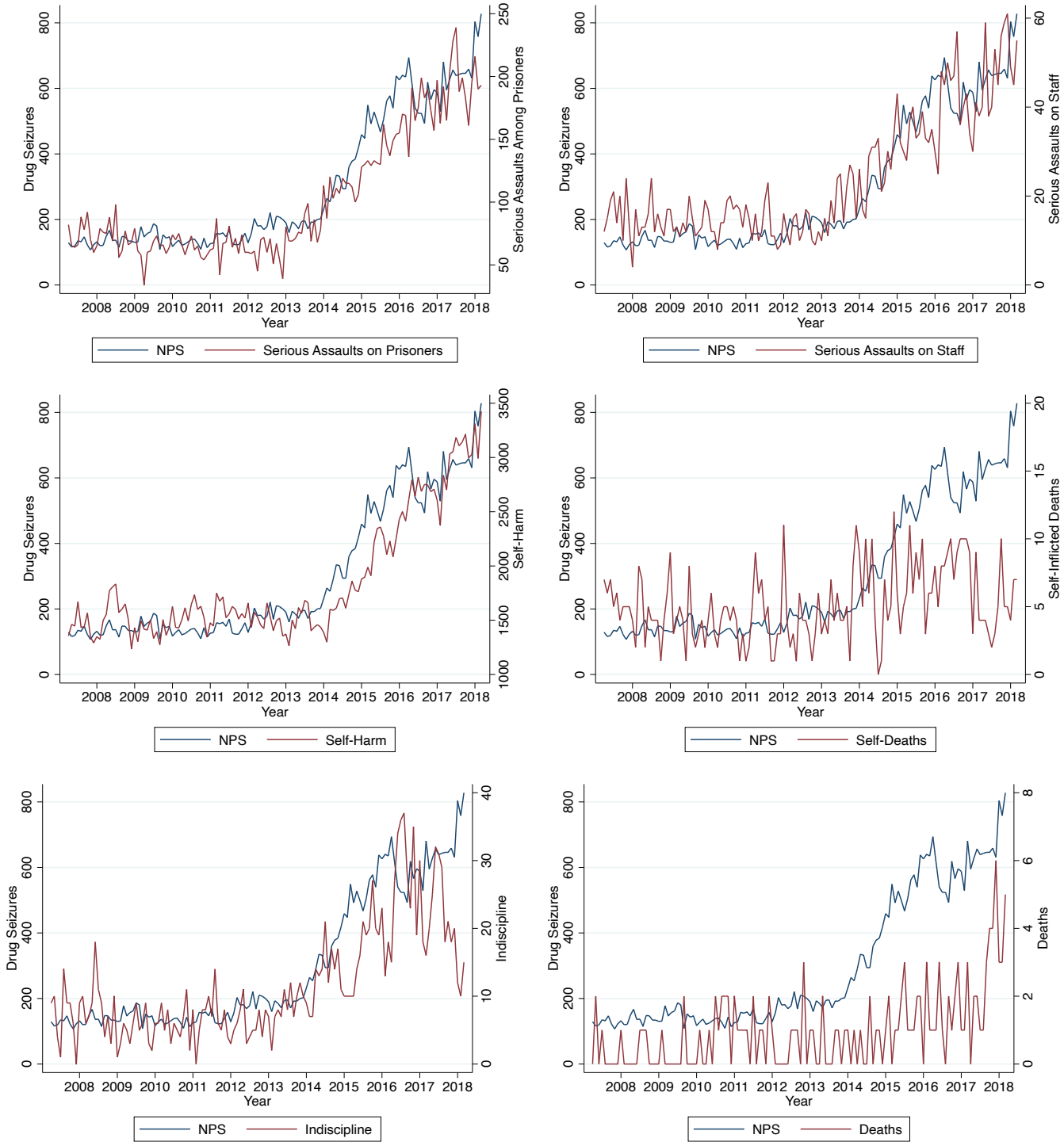
Notes: Number of NPS detected each year reported to the EU Early Warning System

Figure II
The Spreading of NPS in England and Wales Prisons



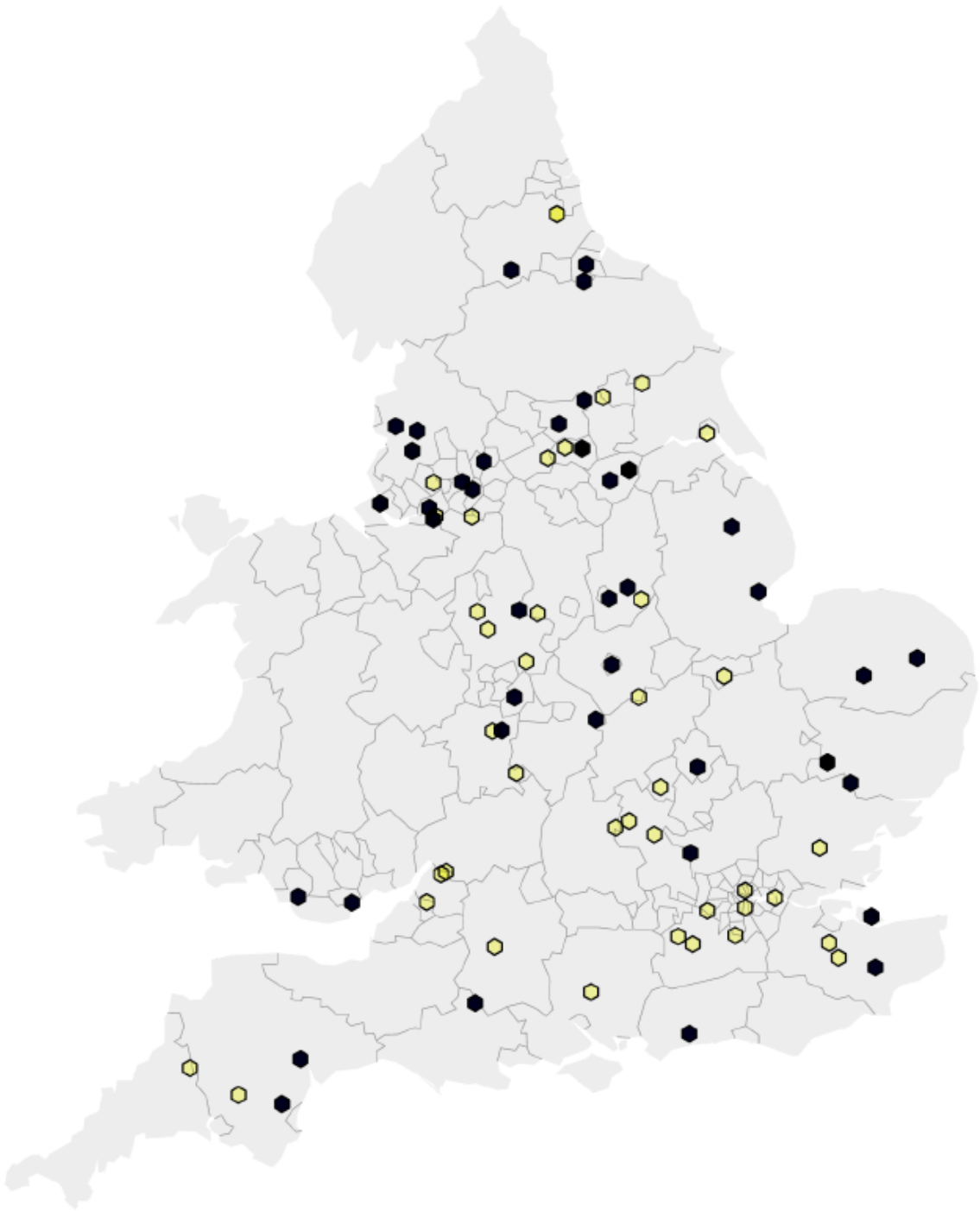
Notes: Seizures and positive drug tests information referred to the balanced sample of 96 England and Wales prisons from April 2007 to March 2018. Data on NPS positive tests are only available for the last year of the sample.

Figure III
NPS, Harm, and Violence in England and Wales Prisons



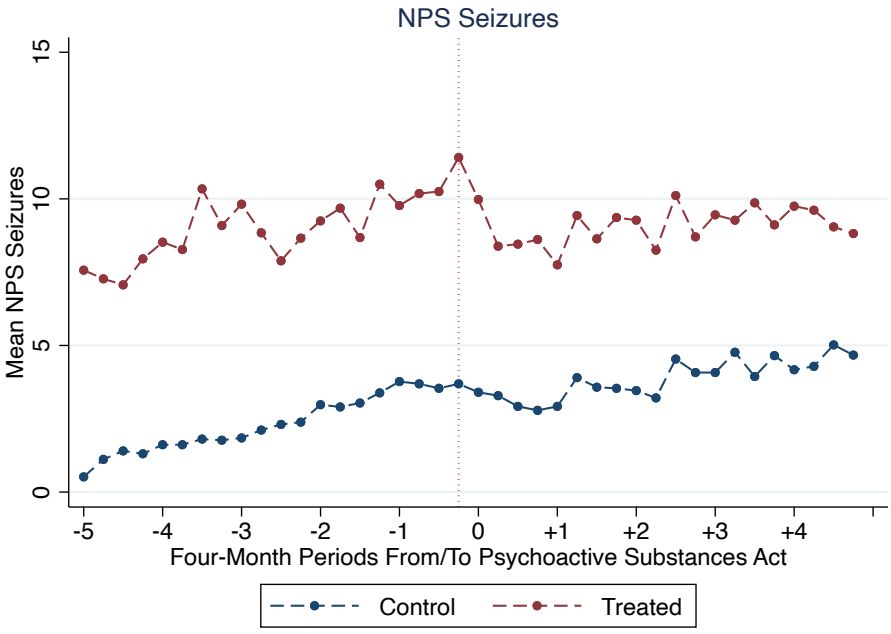
Notes: NPS seizures, violence, harm, and deaths on the balanced sample of 96 England and Wales prisons from April 2007 to March 2018.

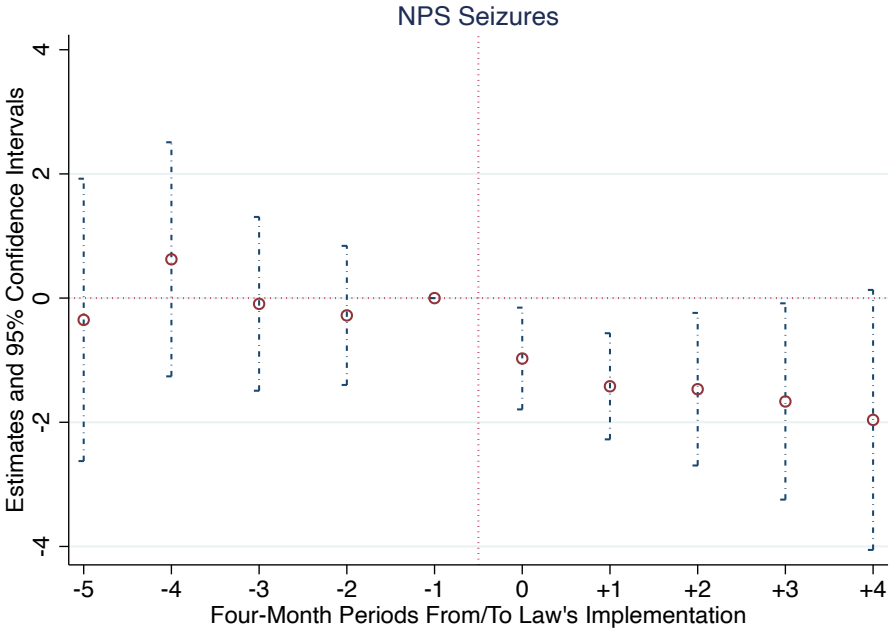
Figure IV
Map of England and Wales Prisons



Notes: Map of prisons included in the baseline sample. Black hexagons indicate prisons in the HINPST group. Lighter hexagons indicate prisons in the LINPS group.

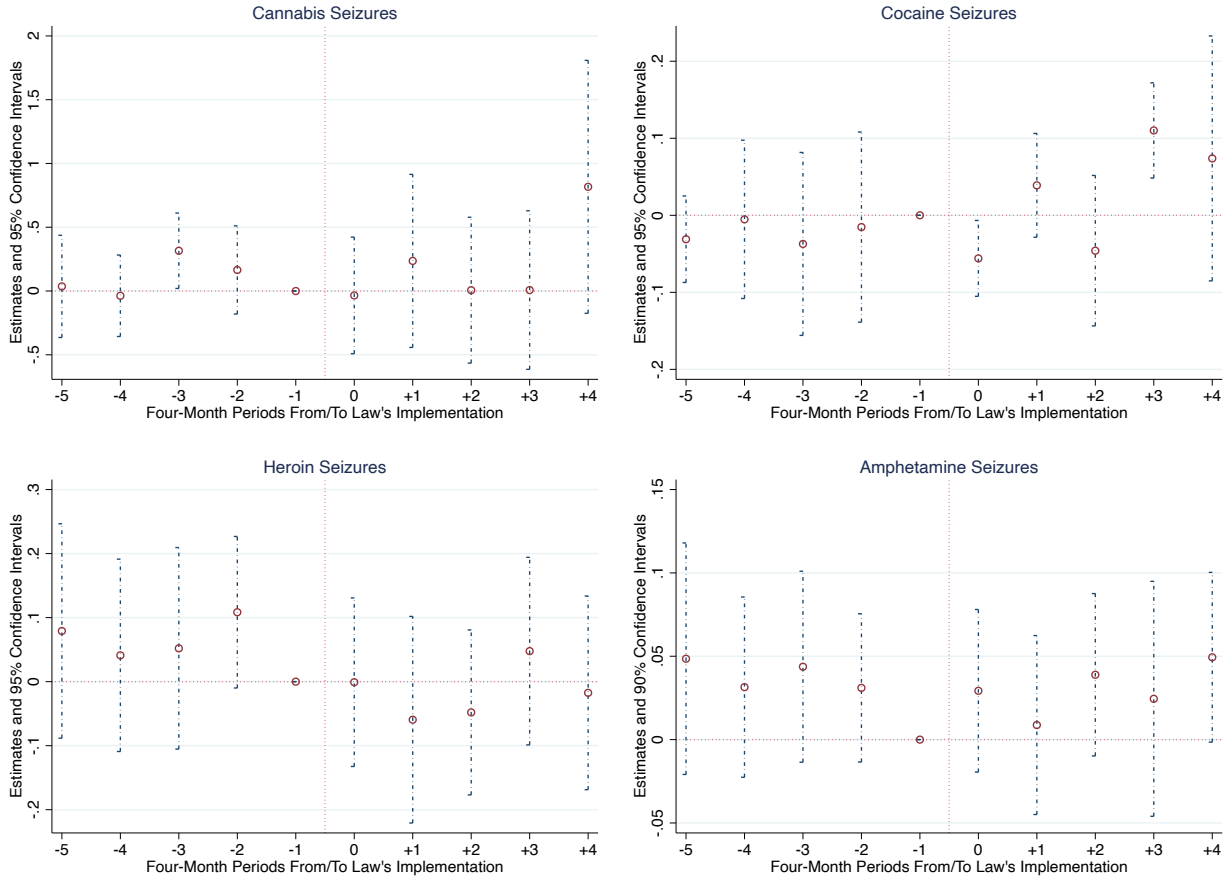
Figure V
The Impact of the Psychoactive Substances Act 2016 on NPS Seizures





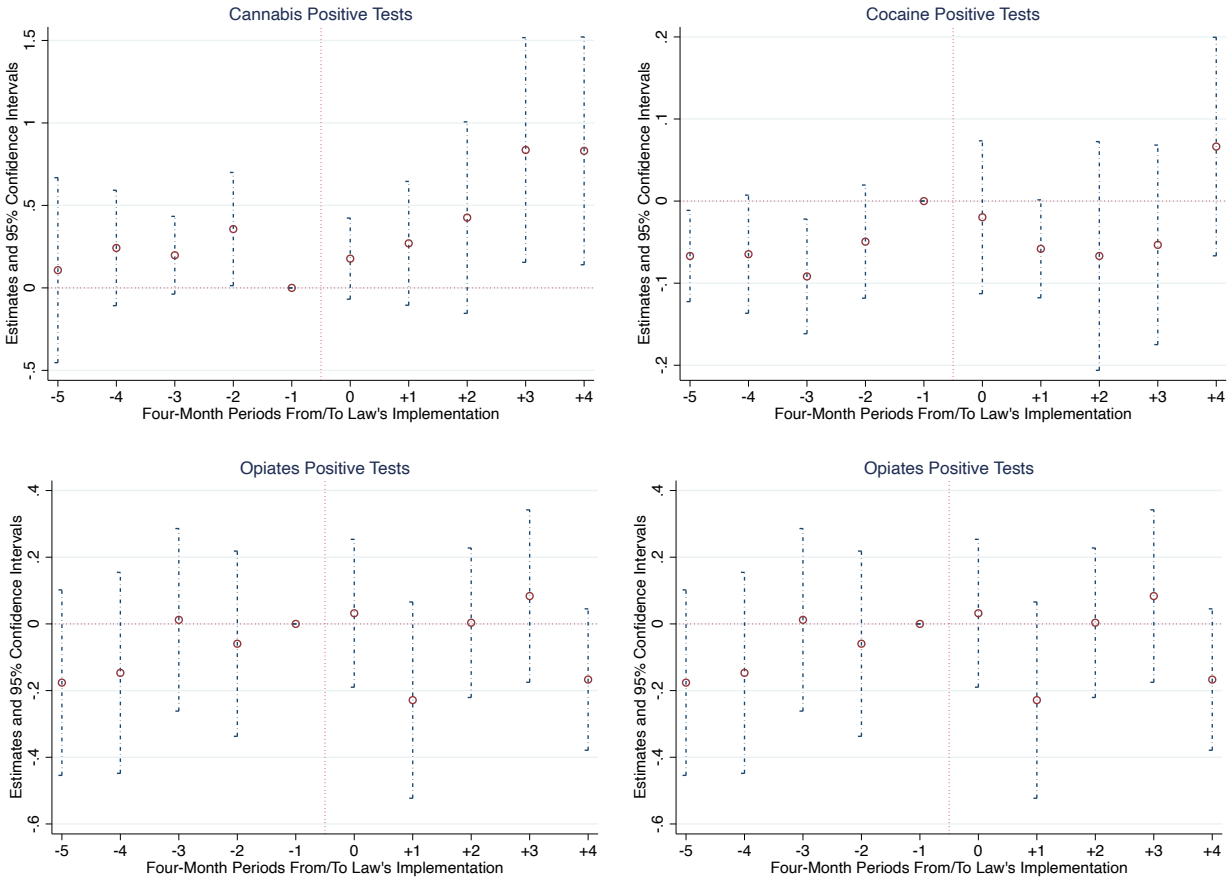
Notes: The sample includes 96 prison for 40 months, 20 before and 20 after the act (96×40=3,840 observations). The bottom figure reports estimates and confidence interval of τ obtained from event-study estimating equation (3).

Figure VI-A
The Impact of PSA 2016 on the Market of Conventional Illegal Drugs (Seizures)



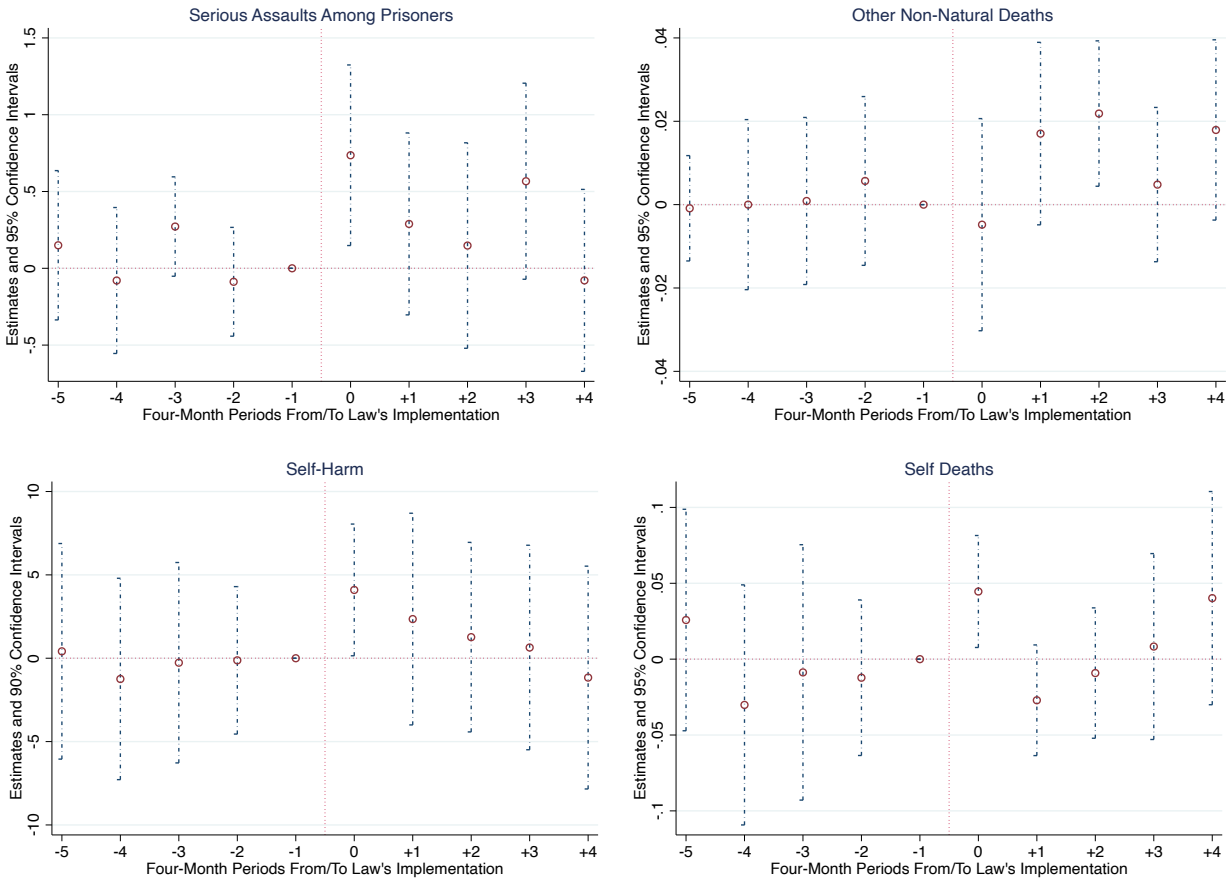
Notes: The sample includes 96 prison for 40 months, 20 before and 20 after the act (96×40=3,840 observations). Figure reports estimates and confidence interval of τ obtained from event-study estimating equation (3).

Figure VI-B
The Impact of PSA 2016 on the Market of Conventional Illegal Drugs (RMDT)



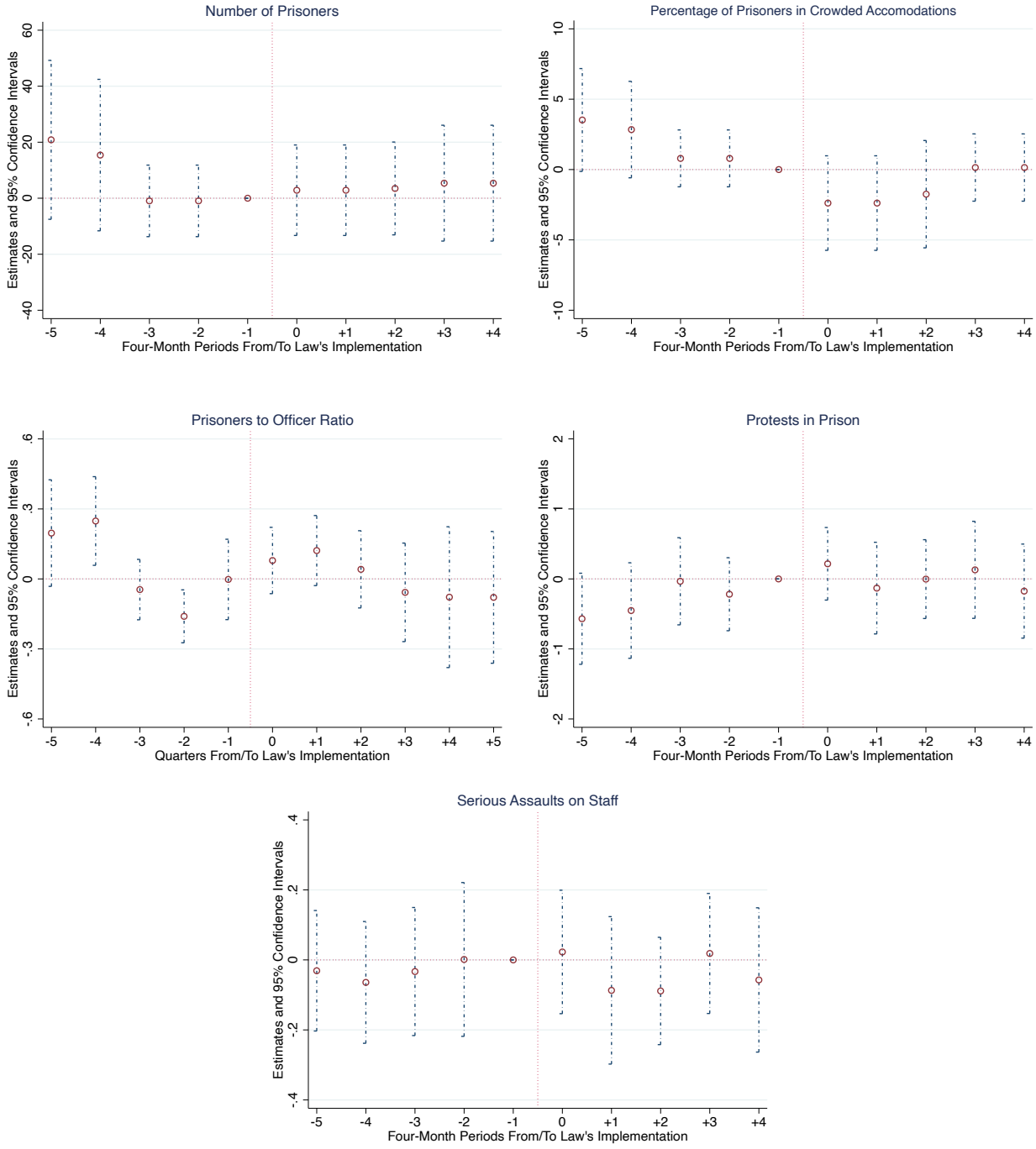
Notes: The sample includes 96 prison for 40 months, 20 before and 20 after the act (96×40=3,840 observations). Figure reports estimates and confidence interval of τ obtained from event-study estimating equation (3). We display the effects on random mandatory drug tests (RMDT) positive results.

Figure VII
The Impact of PSA 2016 on Violence, Deaths, and Self Harm



Notes: The sample includes 96 prison for 40 months, 20 before and 20 after the act (96×40=3,840 observations). Figure reports estimates and confidence interval of τ obtained from event-study estimating equation (3).

Figure VIII
Exploring Potential Interpretation Confounders



Notes: The sample for the number of prisoners and percentage of prisoners in crowded accommodations includes 96 prisons for 3,840 observations. The sample for prisoners to officer ratio includes 83 prisons for 993 observations, due to missing data and quarterly (instead of monthly) reported information on prison officers. The figure reports estimates and confidence interval of τ obtained from event-study estimating equation (3) adapted to quarterly data in the bottom-left figure.

Appendix: Not Intended for Publication

Table A1
Robustness to Alternative Definitions of NPS

	(1)	(2)	(3)	(4)	(5)
	NPS Seizures				
Post × HINPST	-1.478**	-1.954**	-2.386***	-1.387**	-1.364***
	(0.727)	(0.749)	(0.682)	(0.592)	(0.491)
Observations	3,840	3,840	3,840	2,688	2,688

Notes: This table shows estimates of the impact of the Psychoactive Substances Act 2016 on NPS seizures for alternative measure of NPS. 'Post' is an indicator variable taking the value of one in May 2016 and afterwards; zero otherwise. 'HINPST" is an indicator variable taking the value of one if the number of NPS seizures 20 months prior to the implementation of the Act is above the corresponding median; zero otherwise. The sample includes 96 prisons measured for 40 months, 20 before and 20 after the act (96×40=3,840 observations). All regressions include prison fixed effects and year-by-month fixed effects. Standard errors displayed in parenthesis are clustered two-way at the prison and year-by-month level. Column 1 shows the baseline. Column 2 excludes seizures measured as 'Other Substances' from September 2015 (when the new recording system started) onwards. Column 3 excludes seizures for 'Unknown Substances'. Column 4 excludes all seizures for 'Other Substances'. Column 5 focuses exclusively on 'Psychoactive Substances'. Columns 4-5 have fewer observations because the corresponding substances are not measured prior to September 2015. *** significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Table A2
The Impact of the Psychoactive Substances Act 2016 on Prisons' Drug Seizures and Positive Drug Tests

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Cannabis Seizures							
Post×HINPST	0.110	0.138	0.0956	0.0229	0.241	0.110	-0.00209	-0.366*
	(0.275)	(0.265)	(0.287)	(0.276)	(0.333)	(0.263)	(0.0673)	(0.187)
	Cocaine Seizures							
Post×HINPST	0.0420	0.0429*	0.0401	-0.00629	0.0610*	0.0420*	0.0202	0.195
	(0.0266)	(0.0260)	(0.0277)	(0.0255)	(0.0326)	(0.0249)	(0.0159)	(0.297)
	Heroin Seizures							
Post×HINPST	-0.0718	-0.0779*	-0.0844*	-0.0467	-0.0762	-0.0718	-0.0427*	-0.321
	(0.0437)	(0.0439)	(0.0451)	(0.0649)	(0.0543)	(0.0443)	(0.0245)	(0.329)
	Amphetamine Seizures							
Post×HINPST	-0.000787	-0.00196	-0.00278	0.0123	0.00563	-0.000787	0.000171	-0.0415
	(0.00951)	(0.00990)	(0.0112)	(0.0236)	(0.0117)	(0.0117)	(0.00581)	(0.346)
	Cannabis Positive Tests							
Post×HINPST	0.327	0.389	0.312	0.0967	0.210	0.327	0.173**	0.133
	(0.286)	(0.278)	(0.299)	(0.189)	(0.348)	(0.286)	(0.0721)	(0.148)
	Cocaine Positive Tests							
Post×HINPST	0.0282	0.0286	0.0326	-0.0178	0.0248	0.0282	0.0149	-0.283
	(0.0413)	(0.0396)	(0.0447)	(0.0332)	(0.0481)	(0.0415)	(0.0240)	(0.249)
	Heroin Positive Tests							
Post×HINPST	0.0187	0.0181	0.000687	-0.112	-0.00924	0.0187	0.00507	-0.0213
	(0.0706)	(0.0716)	(0.0743)	(0.103)	(0.0890)	(0.0748)	(0.0341)	(0.100)
	Amphetamine Positive Tests							
Post×HINPST	-0.0145	-0.0145	-0.0159	-0.00385	-0.0169	-0.0145	-0.00707	-0.621
	(0.0130)	(0.0124)	(0.0149)	(0.0274)	(0.0164)	(0.0140)	(0.00835)	(0.418)

Notes: This table shows estimates of the impact of the Psychoactive Substances Act 2016 on drug seizures and positive drug tests. 'Post' is an indicator variable taking the value of one in May 2016 and afterwards; zero otherwise. 'HINPST' is an indicator variable taking the value of one if the number of NPS seizures 20 months prior to the implementation of the Act is above the corresponding median; zero otherwise. The sample includes 96 prisons measured for 40 months, 20 before and 20 after the act (96×40=3,840 observations). All regressions include prison fixed effects and year-by-month fixed effects. Unless otherwise noted, standard errors displayed in parenthesis are clustered two-way at the prison and year-by-month level. Column 1 shows the baseline. Column 2 includes the number of prisoners and the percentage of prisoners in crowded accommodations. Column 3 includes prison-by-month fixed effects. Column 4 includes prison-specific linear annual trends. Column 5 weights the regression using the number of prisoners as a weight. Column 6 shows standard errors clustered at the prison level. Column 7 displays estimates obtained from a regression where the dependent variable (y) is expressed as log(1+y). Column 8 shows results from a negative binomial count data regression. *** significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Table A3
The Impact of the Psychoactive Substances Act 2016 on Drug-Related Harms in Prison

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				Serious Assault Among Prisoners				
Post×HINPST	0.281	0.292	0.194	0.537**	0.429	0.281	0.0260	-0.0488
	(0.238)	(0.238)	(0.223)	(0.267)	(0.353)	(0.229)	(0.0498)	(0.0958)
				Serious Assault on Staff				
Post×HINPST	-0.0129	-0.0130	-0.0253	-0.0222	0.00244	-0.0129	0.000803	-0.177*
	(0.0396)	(0.0381)	(0.0412)	(0.0665)	(0.0404)	(0.0474)	(0.0191)	(0.0995)
				Indiscipline				
Post×HINPST	0.0599	0.0599	0.0579	0.0684	0.0891	0.0599	0.0273	0.0375
	(0.0458)	(0.0451)	(0.0458)	(0.0767)	(0.0599)	(0.0447)	(0.0232)	(0.220)
				Deaths				
Post×HINPST	0.00883	0.00850	0.0123	-0.00306	0.0101	0.00883	0.00645	0.412
	(0.00907)	(0.00862)	(0.00977)	(0.0149)	(0.0110)	(0.00880)	(0.00598)	(0.538)
				Self-Inflicted Deaths				
Post×HINPST	0.0164	0.0165	0.0116	0.0267	0.0151	0.0164	0.00938	0.246
	(0.0130)	(0.0129)	(0.0144)	(0.0181)	(0.0128)	(0.0149)	(0.00817)	(0.245)
				Self-Harm				
Post×HINPST	1.683	1.399	1.486	3.675*	4.148	1.683	0.00294	0.00908
	(2.487)	(2.517)	(2.511)	(2.169)	(2.656)	(2.500)	(0.0722)	(0.0841)

Notes: This table shows estimates of the impact of the Psychoactive Substances Act 2016 on drug related harms (displayed in panel titles). 'Post' is an indicator variable taking the value of one in May 2016 and afterwards; zero otherwise. 'HINPST" is an indicator variable taking the value of one if the number of NPS seizures 20 months prior to the implementation of the Act is above the corresponding median; zero otherwise. The sample includes 96 prisons measured for 40 months, 20 before and 20 after the act (96×40=3,840 observations). All regressions include prison fixed effects and year-by-month fixed effects. Unless otherwise noted, standard errors displayed in parenthesis are clustered two-way at the prison and year-by-month level. Column 1 shows the baseline. Column 2 includes the number of prisoners and the percentage of prisoners in crowded accommodations. Column 3 includes prison-by-month fixed effects. Column 4 includes prison-specific linear annual trends. Column 5 weights the regression using the number of prisoners as a weight. Column 6 shows standard errors clustered at the prison level. Column 7 displays estimates obtained from a regression where the dependent variable (y) is expressed as log(1+y). Column 8 shows results from a negative binomial count data regression. *** significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Table A4
Event Study Analysis: Robustness

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	NPS Seizures							
HINPST × τ =-5	-0.351	-0.445			-0.847	-0.351	0.266*	0.855***
	(0.925)	(0.927)			(1.248)	(1.026)	(0.147)	(0.255)
HINPST × τ =-4	0.625	0.551		0.800	0.527	0.625	0.262***	0.609***
	(0.717)	(0.724)		(0.896)	(0.957)	(0.818)	(0.0905)	(0.115)
HINPST × τ = -3	-0.0927	-0.106		0.0828	-0.220	-0.0927	0.0957	0.344***
	(0.785)	(0.783)		(1.039)	(1.170)	(0.815)	(0.0661)	(0.103)
HINPST × τ = -2	-0.279	-0.292		-0.103	-0.684	-0.279	0.0679	0.137**
	(0.386)	(0.389)		(0.622)	(0.585)	(0.551)	(0.0543)	(0.0692)
HINPST × τ = 0	-0.973*	-0.932*	-0.881	-0.973	-1.159	-0.973	-0.0512	0.00855
	(0.534)	(0.550)	(0.583)	(0.585)	(0.695)	(0.642)	(0.0776)	(0.0971)
HINPST × τ = 1	-1.420**	-1.380*	-1.106*	-1.420*	-1.717*	-1.420*	-0.108	-0.0794
	(0.694)	(0.712)	(0.630)	(0.763)	(0.975)	(0.819)	(0.0950)	(0.131)
HINPST × τ = 2	-1.467**	-1.439**	-1.780**	-1.643	-1.898**	-1.467*	-0.121	-0.0990
	(0.637)	(0.652)	(0.767)	(1.053)	(0.769)	(0.759)	(0.0953)	(0.136)
HINPST × τ = 3	-1.665*	-1.675*	-1.572	-1.840	-1.874*	-1.665*	-0.235**	-0.244*
	(0.827)	(0.833)	(1.065)	(1.128)	(1.067)	(0.953)	(0.0966)	(0.138)
HINPST × τ = 4	-1.962	-1.972	-1.647	-2.137	-2.860*	-1.962	-0.235**	-0.269
	(1.176)	(1.185)	(1.354)	(1.486)	(1.641)	(1.343)	(0.110)	(0.169)
Observations	3,840	3,840	3,840	3,840	3,840	3,840	3,840	3,840

Notes: This table shows event study estimates of the impact of the Psychoactive Substances Act 2016 on an outcome displayed in the panel title. "HINPST" is an indicator variable taking the value of one if the number of NPS seizures 20 months prior to the implementation of the Act is above the corresponding median; zero otherwise. Numbers from -5 to +4 correspond to four-month periods leading and following the Act. We exclude the interaction corresponding to the period prior to the implementation (-1). The sample includes 96 prisons measured for 40 months, 20 before and 20 after the act (96×40=3,840 observations). All regressions include prison fixed effects and year-by-month fixed effects. Unless otherwise noted, standard errors displayed in parenthesis are clustered two-way at the prison and year-by-month level. Column 1 shows the baseline. Column 2 includes the number of prisoners and the percentage of prisoners in crowded accommodations. Column 3 includes prison-by-month fixed effects. Due to multicollinearity with the event study dummies we omit all pre-intervention interaction dummies. Column 4 includes prison-specific linear annual trends. Column 5 weights the regression using the number of prisoners as a weight. Column 6 shows standard errors clustered at the prison level. Column 7 displays estimates obtained from a regression where the dependent variable (y) is expressed as log(1+y). Column 8 shows results from a negative binomial count data regression. *** significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Table A5
Event Study Analysis: Robustness

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Cannabis Seizures							
HINPST × τ =-5	0.0363	-0.0240		0.0503	0.0262	0.0363	0.0782	0.391
	(0.197)	(0.208)		(0.267)	(0.251)	(0.214)	(0.0751)	(0.296)
HINPST × τ =-4	-0.0372	-0.0836		-0.0302	-0.0577	-0.0372	0.0344	0.202
	(0.158)	(0.169)		(0.161)	(0.200)	(0.201)	(0.0605)	(0.256)
HINPST × τ = -3	0.316**	0.311**		0.323*	0.428*	0.316	0.173***	0.579**
	(0.145)	(0.145)		(0.167)	(0.218)	(0.196)	(0.0527)	(0.245)
HINPST × τ = -2	0.165	0.160		0.172	0.319	0.165	0.0913	0.239
	(0.171)	(0.172)		(0.220)	(0.203)	(0.198)	(0.0678)	(0.228)
HINPST × τ = 0	-0.0345	-0.0196	-0.350	-0.0345	-0.0329	-0.0345	0.00120	-0.190
	(0.226)	(0.231)	(0.230)	(0.228)	(0.247)	(0.200)	(0.0885)	(0.248)
HINPST × τ = 1	0.236	0.251	0.135	0.236	0.471	0.236	0.0601	-0.0913
	(0.335)	(0.342)	(0.354)	(0.342)	(0.417)	(0.334)	(0.0879)	(0.301)
HINPST × τ = 2	0.00656	0.0154	0.0251	-0.000437	0.125	0.00656	0.00164	-0.269
	(0.281)	(0.282)	(0.338)	(0.236)	(0.321)	(0.336)	(0.0646)	(0.228)
HINPST × τ = 3	0.00743	-0.00194	-0.308	0.000437	0.126	0.00743	0.0556	-0.176
	(0.307)	(0.316)	(0.387)	(0.246)	(0.284)	(0.344)	(0.0595)	(0.254)
HINPST × τ = 4	0.817	0.808	0.716	0.810*	1.231*	0.817*	0.248**	0.226
	(0.489)	(0.496)	(0.474)	(0.458)	(0.663)	(0.443)	(0.0960)	(0.264)
Observations	3,840	3,840	3,840	3,840	3,840	3,840	3,840	3,840

Notes: This table shows event study estimates of the impact of the Psychoactive Substances Act 2016 on an outcome displayed in the panel title. "HINPST" is an indicator variable taking the value of one if the number of NPS seizures 20 months prior to the implementation of the Act is above the corresponding median; zero otherwise. Numbers from -5 to +4 correspond to four-month periods leading and following the Act. We exclude the interaction corresponding to the period prior to the implementation (-1). The sample includes 96 prisons measured for 40 months, 20 before and 20 after the act (96×40=3,840 observations). All regressions include prison fixed effects and year-by-month fixed effects. Unless otherwise noted, standard errors displayed in parenthesis are clustered two-way at the prison and year-by-month level. Column 1 shows the baseline. Column 2 includes the number of prisoners and the percentage of prisoners in crowded accommodations. Column 3 includes prison-by-month fixed effects. Due to multicollinearity with the event study dummies we omit all pre-intervention interaction dummies. Column 4 includes prison-specific linear annual trends. Column 5 weights the regression using the number of prisoners as a weight. Column 6 shows standard errors clustered at the prison level. Column 7 displays estimates obtained from a regression where the dependent variable (y) is expressed as log(1+y). Column 8 shows results from a negative binomial count data regression. *** significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Table A6
Event Study Analysis: Robustness

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Cocaine Seizures							
HINPST × τ =-5	-0.0310	-0.0349		0.0240	-0.0101	-0.0310	-0.0110	-0.138
	(0.0278)	(0.0292)		(0.0379)	(0.0329)	(0.0427)	(0.0202)	(0.445)
HINPST × τ = -4	-0.00524	-0.00808		0.0223	0.0133	-0.00524	0.00880	0.335
	(0.0504)	(0.0508)		(0.0497)	(0.0501)	(0.0547)	(0.0320)	(0.750)
HINPST × τ = -3	-0.0372	-0.0368		-0.00962	-0.0118	-0.0372	-0.0177	-0.325
	(0.0586)	(0.0586)		(0.0613)	(0.0631)	(0.0507)	(0.0370)	(0.622)
HINPST × τ = -2	-0.0153	-0.0150		0.0122	0.0220	-0.0153	-0.00450	-0.185
	(0.0608)	(0.0607)		(0.0622)	(0.0610)	(0.0633)	(0.0341)	(0.622)
HINPST × τ = 0	-0.0559**	-0.0569**	-0.0188	-0.0559**	-0.0533**	-0.0559	-0.0241**	-0.436
	(0.0244)	(0.0240)	(0.0475)	(0.0249)	(0.0236)	(0.0448)	(0.0110)	(0.352)
HINPST × τ = 1	0.0389	0.0380	0.0621	0.0389	0.105**	0.0389	0.0194	0.238
	(0.0328)	(0.0328)	(0.0382)	(0.0352)	(0.0435)	(0.0620)	(0.0239)	(0.470)
HINPST × τ = 2	-0.0459	-0.0469	-0.0433	-0.0734	-0.0210	-0.0459	-0.0189	-0.494
	(0.0481)	(0.0475)	(0.0426)	(0.0529)	(0.0465)	(0.0583)	(0.0283)	(0.487)
HINPST × τ = 3	0.110***	0.109***	0.147**	0.0826**	0.124***	0.110**	0.0679***	0.786**
	(0.0306)	(0.0306)	(0.0588)	(0.0370)	(0.0316)	(0.0534)	(0.0225)	(0.381)
HINPST × τ = 4	0.0739	0.0728	0.0970	0.0463	0.164	0.0739	0.0322	0.377
	(0.0784)	(0.0784)	(0.0790)	(0.0807)	(0.120)	(0.0885)	(0.0387)	(0.570)
Observations	3,840	3,840	3,840	3,840	3,840	3,840	3,840	3,840

Notes: This table shows event study estimates of the impact of the Psychoactive Substances Act 2016 on an outcome displayed in the panel title. "HINPST" is an indicator variable taking the value of one if the number of NPS seizures 20 months prior to the implementation of the Act is above the corresponding median; zero otherwise. Numbers from -5 to +4 correspond to four-month periods leading and following the Act. We exclude the interaction corresponding to the period prior to the implementation (-1). The sample includes 96 prisons measured for 40 months, 20 before and 20 after the act (96×40=3,840 observations). All regressions include prison fixed effects and year-by-month fixed effects. Unless otherwise noted, standard errors displayed in parenthesis are clustered two-way at the prison and year-by-month level. Column 1 shows the baseline. Column 2 includes the number of prisoners and the percentage of prisoners in crowded accommodations. Column 3 includes prison-by-month fixed effects. Due to multicollinearity with the event study dummies we omit all pre-intervention interaction dummies. Column 4 includes prison-specific linear annual trends. Column 5 weights the regression using the number of prisoners as a weight. Column 6 shows standard errors clustered at the prison level. Column 7 displays estimates obtained from a regression where the dependent variable (y) is expressed as log(1+y). Column 8 shows results from a negative binomial count data regression. *** significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Table A7
Event Study Analysis: Robustness

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Cannabis Positive Tests							
HINPST × τ = -5	0.108	0.0578		0.00758	0.0886	0.108	0.0321	0.0845
	(0.277)	(0.260)		(0.356)	(0.414)	(0.314)	(0.0751)	(0.251)
HINPST × τ = -4	0.242	0.200		0.192	0.304	0.242	0.0760	0.215
	(0.173)	(0.154)		(0.173)	(0.217)	(0.236)	(0.0567)	(0.151)
HINPST × τ = -3	0.198*	0.180		0.148	0.268	0.198	0.0574	0.194
	(0.117)	(0.114)		(0.120)	(0.176)	(0.185)	(0.0402)	(0.120)
HINPST × τ = -2	0.357**	0.338**		0.307	0.497*	0.357	0.0945*	0.322*
	(0.168)	(0.167)		(0.192)	(0.252)	(0.229)	(0.0522)	(0.167)
HINPST × τ = 0	0.177	0.233*	-0.0205	0.177	0.0915	0.177	0.126***	0.176
	(0.122)	(0.122)	(0.201)	(0.117)	(0.169)	(0.195)	(0.0435)	(0.114)
HINPST × τ = 1	0.270	0.325*	0.0380	0.270	0.276	0.270	0.142**	0.183**
	(0.185)	(0.173)	(0.369)	(0.171)	(0.232)	(0.264)	(0.0528)	(0.0887)
HINPST × τ = 2	0.426	0.468	0.305	0.476**	0.222	0.426	0.239***	0.264*
	(0.285)	(0.294)	(0.328)	(0.202)	(0.362)	(0.353)	(0.0623)	(0.143)
HINPST × τ = 3	0.836**	0.840**	0.638	0.886***	0.736*	0.836**	0.311***	0.403**
	(0.335)	(0.334)	(0.418)	(0.267)	(0.388)	(0.405)	(0.0795)	(0.173)
HINPST × τ = 4	0.831**	0.835**	0.599	0.881***	0.884**	0.831**	0.308***	0.393*
	(0.342)	(0.341)	(0.387)	(0.320)	(0.392)	(0.349)	(0.0920)	(0.201)
Observations	3,840	3,840	3,840	3,840	3,840	3,840	3,840	3,840

Notes: This table shows event study estimates of the impact of the Psychoactive Substances Act 2016 on an outcome displayed in the panel title. "HINPST" is an indicator variable taking the value of one if the number of NPS seizures 20 months prior to the implementation of the Act is above the corresponding median; zero otherwise. Numbers from -5 to +4 correspond to four-month periods leading and following the Act. We exclude the interaction corresponding to the period prior to the implementation (-1). The sample includes 96 prisons measured for 40 months, 20 before and 20 after the act (96×40=3,840 observations). All regressions include prison fixed effects and year-by-month fixed effects. Unless otherwise noted, standard errors displayed in parenthesis are clustered two-way at the prison and year-by-month level. Column 1 shows the baseline. Column 2 includes the number of prisoners and the percentage of prisoners in crowded accommodations. Column 3 includes prison-by-month fixed effects. Due to multicollinearity with the event study dummies we omit all pre-intervention interaction dummies. Column 4 includes prison-specific linear annual trends. Column 5 weights the regression using the number of prisoners as a weight. Column 6 shows standard errors clustered at the prison level. Column 7 displays estimates obtained from a regression where the dependent variable (y) is expressed as log(1+y). Column 8 shows results from a negative binomial count data regression. *** significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Table A8
Event Study Analysis: Robustness

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Serious Assaults Among Prisoners							
HINPST × τ = -5	0.150	0.100		-0.357	0.134	0.150	0.0920	0.426**
	(0.240)	(0.242)		(0.295)	(0.321)	(0.279)	(0.0599)	(0.170)
HINPST × τ = -4	-0.0795	-0.117		-0.333	-0.299	-0.0795	0.0135	0.0742
	(0.234)	(0.236)		(0.236)	(0.297)	(0.263)	(0.0789)	(0.148)
HINPST × τ = -3	0.272*	0.272*		0.0182	0.256	0.272	0.110*	0.275**
	(0.159)	(0.159)		(0.222)	(0.210)	(0.206)	(0.0607)	(0.125)
HINPST × τ = -2	-0.0878	-0.0879		-0.341	-0.191	-0.0878	0.0527	-0.00371
	(0.175)	(0.177)		(0.219)	(0.177)	(0.203)	(0.0566)	(0.126)
HINPST × τ = 0	0.736**	0.736**	0.464**	0.736**	0.923**	0.736***	0.198***	0.334**
	(0.290)	(0.295)	(0.189)	(0.294)	(0.408)	(0.254)	(0.0707)	(0.167)
HINPST × τ = 1	0.289	0.289	0.258	0.289	0.389	0.289	0.0418	0.101
	(0.292)	(0.294)	(0.311)	(0.298)	(0.415)	(0.306)	(0.0693)	(0.160)
HINPST × τ = 2	0.148	0.146	0.188	0.402	0.148	0.148	0.0293	0.0178
	(0.330)	(0.333)	(0.294)	(0.324)	(0.427)	(0.289)	(0.0872)	(0.180)
HINPST × τ = 3	0.567*	0.556*	0.295	0.820***	0.842*	0.567	0.146**	0.116
	(0.315)	(0.317)	(0.300)	(0.261)	(0.480)	(0.363)	(0.0665)	(0.137)
HINPST × τ = 4	-0.0787	-0.0897	-0.110	0.175	-0.257	-0.0787	-0.0162	-0.126
	(0.293)	(0.290)	(0.256)	(0.265)	(0.446)	(0.326)	(0.0727)	(0.149)
Observations	3,840	3,840	3,840	3,840	3,840	3,840	3,840	3,840

Notes: This table shows event study estimates of the impact of the Psychoactive Substances Act 2016 on an outcome displayed in the panel title. "HINPST" is an indicator variable taking the value of one if the number of NPS seizures 20 months prior to the implementation of the Act is above the corresponding median; zero otherwise. Numbers from -5 to +4 correspond to four-month periods leading and following the Act. We exclude the interaction corresponding to the period prior to the implementation (-1). The sample includes 96 prisons measured for 40 months, 20 before and 20 after the act (96×40=3,840 observations). All regressions include prison fixed effects and year-by-month fixed effects. Unless otherwise noted, standard errors displayed in parenthesis are clustered two-way at the prison and year-by-month level. Column 1 shows the baseline. Column 2 includes the number of prisoners and the percentage of prisoners in crowded accommodations. Column 3 includes prison-by-month fixed effects. Due to multicollinearity with the event study dummies we omit all pre-intervention interaction dummies. Column 4 includes prison-specific linear annual trends. Column 5 weights the regression using the number of prisoners as a weight. Column 6 shows standard errors clustered at the prison level. Column 7 displays estimates obtained from a regression where the dependent variable (y) is expressed as log(1+y). Column 8 shows results from a negative binomial count data regression. *** significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Table A9
Event Study Analysis: Robustness

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Self-Inflicted Deaths							
HINPST × τ = -5	0.0258	0.0272		-0.0481	0.0114	0.0258	0.0176	0.366
	(0.0359)	(0.0366)		(0.0465)	(0.0464)	(0.0427)	(0.0242)	(0.570)
HINPST × τ = -4	-0.0302	-0.0291		-0.0671	-0.0537	-0.0302	-0.0195	-0.474
	(0.0390)	(0.0389)		(0.0416)	(0.0484)	(0.0379)	(0.0268)	(0.791)
HINPST × τ = -3	-0.00874	-0.00881		-0.0457	-0.0282	-0.00874	-0.00468	-0.130
	(0.0415)	(0.0415)		(0.0442)	(0.0483)	(0.0434)	(0.0279)	(0.606)
HINPST × τ =-2	-0.0122	-0.0123		-0.0492	-0.0398	-0.0122	-0.00848	-0.149
	(0.0253)	(0.0253)		(0.0312)	(0.0325)	(0.0378)	(0.0176)	(0.441)
HINPST × τ = 0	0.0446**	0.0448**	0.0533	0.0446**	0.0276	0.0446	0.0288**	0.457
	(0.0183)	(0.0186)	(0.0354)	(0.0188)	(0.0229)	(0.0390)	(0.0118)	(0.288)
HINPST × τ = 1	-0.0271	-0.0269	-0.0339	-0.0271	-0.0316	-0.0271	-0.0160	-0.327
	(0.0181)	(0.0178)	(0.0321)	(0.0200)	(0.0253)	(0.0375)	(0.0113)	(0.340)
HINPST × τ = 2	-0.00918	-0.00894	0.00590	0.0278	-0.0413	-0.00918	-0.00800	-0.0690
	(0.0213)	(0.0214)	(0.0237)	(0.0321)	(0.0308)	(0.0363)	(0.0141)	(0.426)
HINPST × τ = 3	0.00830	0.00867	0.0170	0.0453	-0.000530	0.00830	0.00576	0.624
	(0.0300)	(0.0300)	(0.0182)	(0.0369)	(0.0400)	(0.0392)	(0.0209)	(0.671)
HINPST × τ = 4	0.0402	0.0406	0.0334	0.0772*	0.0110	0.0402	0.0213	0.685
	(0.0341)	(0.0343)	(0.0243)	(0.0404)	(0.0402)	(0.0464)	(0.0217)	(0.484)
Observations	3,840	3,840	3,840	3,840	3,840	3,840	3,840	3,840

Notes: This table shows event study estimates of the impact of the Psychoactive Substances Act 2016 on an outcome displayed in the panel title. "HINPST" is an indicator variable taking the value of one if the number of NPS seizures 20 months prior to the implementation of the Act is above the corresponding median; zero otherwise. Numbers from -5 to +4 correspond to four-month periods leading and following the Act. We exclude the interaction corresponding to the period prior to the implementation (-1). The sample includes 96 prisons measured for 40 months, 20 before and 20 after the act (96×40=3,840 observations). All regressions include prison fixed effects and year-by-month fixed effects. Unless otherwise noted, standard errors displayed in parenthesis are clustered two-way at the prison and year-by-month level. Column 1 shows the baseline. Column 2 includes the number of prisoners and the percentage of prisoners in crowded accommodations. Column 3 includes prison-by-month fixed effects. Due to multicollinearity with the event study dummies we omit all pre-intervention interaction dummies. Column 4 includes prison-specific linear annual trends. Column 5 weights the regression using the number of prisoners as a weight. Column 6 shows standard errors clustered at the prison level. Column 7 displays estimates obtained from a regression where the dependent variable (y) is expressed as log(1+y). Column 8 shows results from a negative binomial count data regression. *** significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Table A10
Event Study Analysis: Robustness

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Self-Harm							
HINPST × τ = -5	0.415	0.834		-3.085	-2.286	0.415	0.138*	0.105
	(3.192)	(3.413)		(2.780)	(3.186)	(3.454)	(0.0790)	(0.0992)
HINPST × τ = -4	-1.243	-0.913		-2.993	-2.952	-1.243	0.0112	-0.0295
	(2.982)	(3.085)		(2.638)	(2.875)	(3.140)	(0.0887)	(0.104)
HINPST × τ = -3	-0.268	-0.203		-2.018	-2.208	-0.268	0.0427	0.0233
	(2.966)	(2.960)		(2.788)	(3.079)	(3.081)	(0.0865)	(0.109)
HINPST × τ = -2	-0.126	-0.0612		-1.876	-2.384	-0.126	0.00198	-0.00561
	(2.182)	(2.151)		(1.952)	(2.919)	(2.445)	(0.0510)	(0.0736)
HINPST × τ = 0	4.097**	3.901*	4.365	4.097**	4.405*	4.097*	0.152**	0.160**
	(1.940)	(1.971)	(2.817)	(1.984)	(2.461)	(2.366)	(0.0624)	(0.0779)
HINPST × τ = 1	2.349	2.154	2.204	2.349	3.107	2.349	0.0851	0.0665
	(3.137)	(3.121)	(3.126)	(3.199)	(2.816)	(3.416)	(0.0807)	(0.108)
HINPST × τ = 2	1.265	1.129	1.887	3.015	1.281	1.265	-0.00378	-0.0104
	(2.805)	(2.777)	(2.306)	(3.077)	(3.094)	(2.877)	(0.0931)	(0.103)
HINPST × τ = 3	0.644	0.684	0.912	2.394	2.319	0.644	0.0201	-0.0174
	(3.028)	(2.981)	(3.377)	(2.722)	(3.134)	(3.185)	(0.0825)	(0.102)
HINPST × τ = 4	-1.160	-1.119	-1.304	0.590	-0.191	-1.160	-0.0451	-0.0652
	(3.299)	(3.252)	(3.889)	(3.014)	(3.456)	(3.570)	(0.0993)	(0.113)
Observations	3,840	3,840	3,840	3,840	3,840	3,840	3,840	3,840

Notes: This table shows event study estimates of the impact of the Psychoactive Substances Act 2016 on an outcome displayed in the panel title. "HINPST" is an indicator variable taking the value of one if the number of NPS seizures 20 months prior to the implementation of the Act is above the corresponding median; zero otherwise. Numbers from -5 to +4 correspond to four-month periods leading and following the Act. We exclude the interaction corresponding to the period prior to the implementation (-1). The sample includes 96 prisons measured for 40 months, 20 before and 20 after the act (96×40=3,840 observations). All regressions include prison fixed effects and year-by-month fixed effects. Unless otherwise noted, standard errors displayed in parenthesis are clustered two-way at the prison and year-by-month level. Column 1 shows the baseline. Column 2 includes the number of prisoners and the percentage of prisoners in crowded accommodations. Column 3 includes prison-by-month fixed effects. Due to multicollinearity with the event study dummies we omit all pre-intervention interaction dummies. Column 4 includes prison-specific linear annual trends. Column 5 weights the regression using the number of prisoners as a weight. Column 6 shows standard errors clustered at the prison level. Column 7 displays estimates obtained from a regression where the dependent variable (y) is expressed as log(1+y). Column 8 shows results from a negative binomial count data regression. *** significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Table A11
Event Study Analysis: Robustness

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Homicides							
HINPST × τ = -5	0.0105	0.0103			0.0117	0.0105	0.00727	.
	(0.00664)	(0.00632)			(0.00779)	(0.00745)	(0.00460)	(.)
HINPST × τ = -4	0.0105	0.0103		0.00524	0.0117	0.0105	0.00727	.
	(0.00664)	(0.00635)		(0.0146)	(0.00776)	(0.00745)	(0.00460)	(.)
HINPST × τ = -3	0.00568	0.00564		0.000437	0.00654	0.00568	0.00394	.
	(0.00892)	(0.00886)		(0.00962)	(0.00948)	(0.00892)	(0.00618)	(.)
HINPST × τ = -2	0.00568	0.00564		0.000437	0.00633	0.00568	0.00394	.
	(0.00875)	(0.00870)		(0.0161)	(0.00954)	(0.00892)	(0.00607)	(.)
HINPST × τ = 0	-0	0.000134	-0.00568	-0	-0.000309	-0	-0	.
	(0.00634)	(0.00630)	(0.00772)	(0.00756)	(0.00533)	(0.00688)	(0.00439)	(.)
HINPST × τ = 1	-0	0.000134	-0.00809	-0	-0.00605	-0	-0	.
	(0.00601)	(0.00597)	(0.00559)	(0.00737)	(0.00948)	(0.00688)	(0.00416)	(.)
HINPST × τ = 2	0.00481	0.00491	-0.000437	0.0101	0.00376	0.00481	0.00333	.
	(0.00410)	(0.00403)	(0.00376)	(0.00783)	(0.00321)	(0.00482)	(0.00284)	(.)
HINPST × τ = 3	-0	-2.34e-06	-0.00568	0.00524	-0.000356	-0	-0	.
	(0.00634)	(0.00624)	(0.00772)	(0.00969)	(0.00525)	(0.00688)	(0.00439)	(.)
HINPST × τ = 4	0.0162**	0.0162**	0.00809	0.0214	0.0157**	0.0162*	0.0112**	.
	(0.00729)	(0.00713)	(0.00851)	(0.0137)	(0.00760)	(0.00929)	(0.00505)	(.)
Observations	3,840	3,840	3,840	3,840	3,840	3,840	3,840	3,840

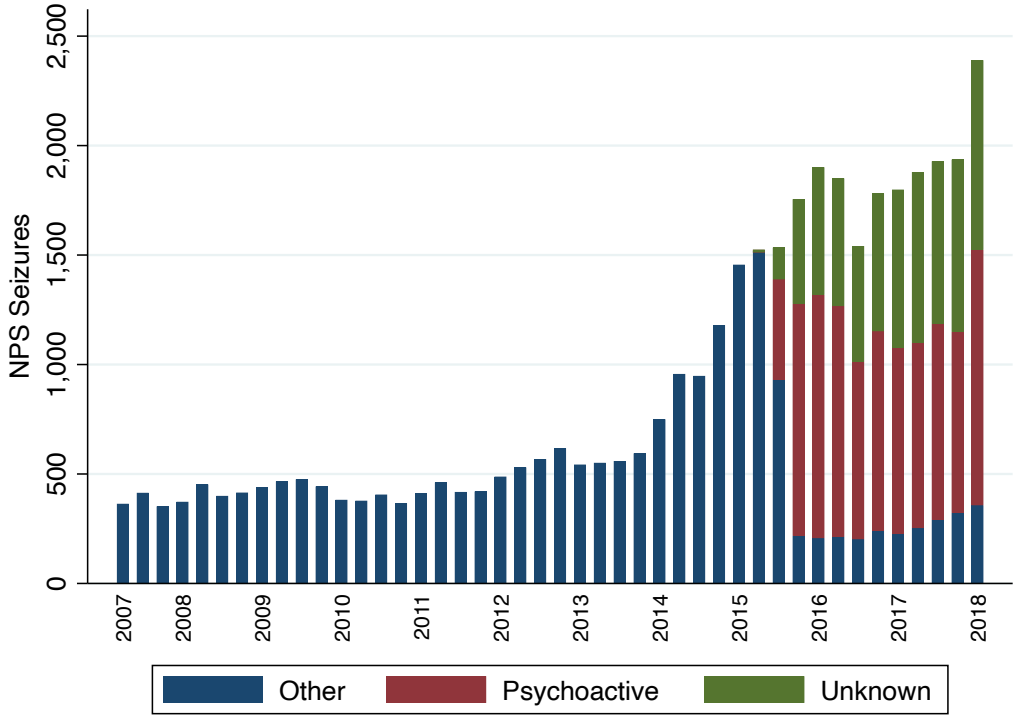
Notes: This table shows event study estimates of the impact of the Psychoactive Substances Act 2016 on an outcome displayed in the panel title. "HINPST" is an indicator variable taking the value of one if the number of NPS seizures 20 months prior to the implementation of the Act is above the corresponding median; zero otherwise. Numbers from -5 to +4 correspond to four-month periods leading and following the Act. We exclude the interaction corresponding to the period prior to the implementation (-1). The sample includes 96 prisons measured for 40 months, 20 before and 20 after the act (96×40=3,840 observations). All regressions include prison fixed effects and year-by-month fixed effects. Unless otherwise noted, standard errors displayed in parenthesis are clustered two-way at the prison and year-by-month level. Column 1 shows the baseline. Column 2 includes the number of prisoners and the percentage of prisoners in crowded accommodations. Column 3 includes prison-by-month fixed effects. Due to multicollinearity with the event study dummies we omit all pre-intervention interaction dummies. Column 4 includes prison-specific linear annual trends. Column 5 weights the regression using the number of prisoners as a weight. Column 6 shows standard errors clustered at the prison level. Column 7 displays estimates obtained from a regression where the dependent variable (y) is expressed as log(1+y). Column 8 shows results from a negative binomial count data regression. *** significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Table A12
Event Study Analysis: Robustness

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Non-Natural Deaths							
HINPST × τ = -5	-0.000874	-0.00172			-0.00535	-0.000874	-0.000606	-14.94***
	(0.00625)	(0.00644)			(0.0125)	(0.0101)	(0.00433)	(1.270)
HINPST × τ = -4	0	-0.000576		0.000437	0.00317	0	0	-3.32e-05
	(0.0101)	(0.0102)		(0.0155)	(0.0169)	(0.0127)	(0.00699)	(1.499)
HINPST × τ = -3	0.000874	0.00109		0.00131	0.00507	0.000874	0.000606	0.288
	(0.00991)	(0.00986)		(0.0162)	(0.0128)	(0.0147)	(0.00687)	(1.029)
HINPST × τ = -2	0.00568	0.00590		0.00612	-0.00216	0.00568	0.00394	0.693
	(0.0100)	(0.00997)		(0.0136)	(0.0120)	(0.0121)	(0.00694)	(1.125)
HINPST × τ = 0	-0.00481	-0.00547	-0.00568	-0.00481	-0.00179	-0.00481	-0.00333	-0.405
	(0.0126)	(0.0126)	(0.0173)	(0.0144)	(0.0166)	(0.0136)	(0.00872)	(1.502)
HINPST × τ = 1	0.0170	0.0164	0.0146	0.0170	0.0194	0.0170	0.0118	1.386
	(0.0108)	(0.0106)	(0.0119)	(0.0141)	(0.0149)	(0.0159)	(0.00750)	(1.027)
HINPST × τ = 2	0.0219**	0.0213**	0.0219*	0.0214	0.0270**	0.0219	0.0151**	2.079*
	(0.00862)	(0.00830)	(0.0117)	(0.0172)	(0.0121)	(0.0151)	(0.00598)	(1.072)
HINPST × τ = 3	0.00481	0.00444	0.00393	0.00437	0.00855	0.00481	0.00333	0.693
	(0.00915)	(0.00914)	(0.0142)	(0.0122)	(0.0120)	(0.0117)	(0.00634)	(1.703)
HINPST × τ = 4	0.0179	0.0176	0.0155	0.0175	0.0269	0.0179	0.0124	1.204
	(0.0107)	(3.252)	(0.0101)	(0.0176)	(0.0168)	(0.0160)	(0.00741)	(0.901)
Observations	3,840	3,840	3,840	3,840	3,840	3,840	3,840	3,840

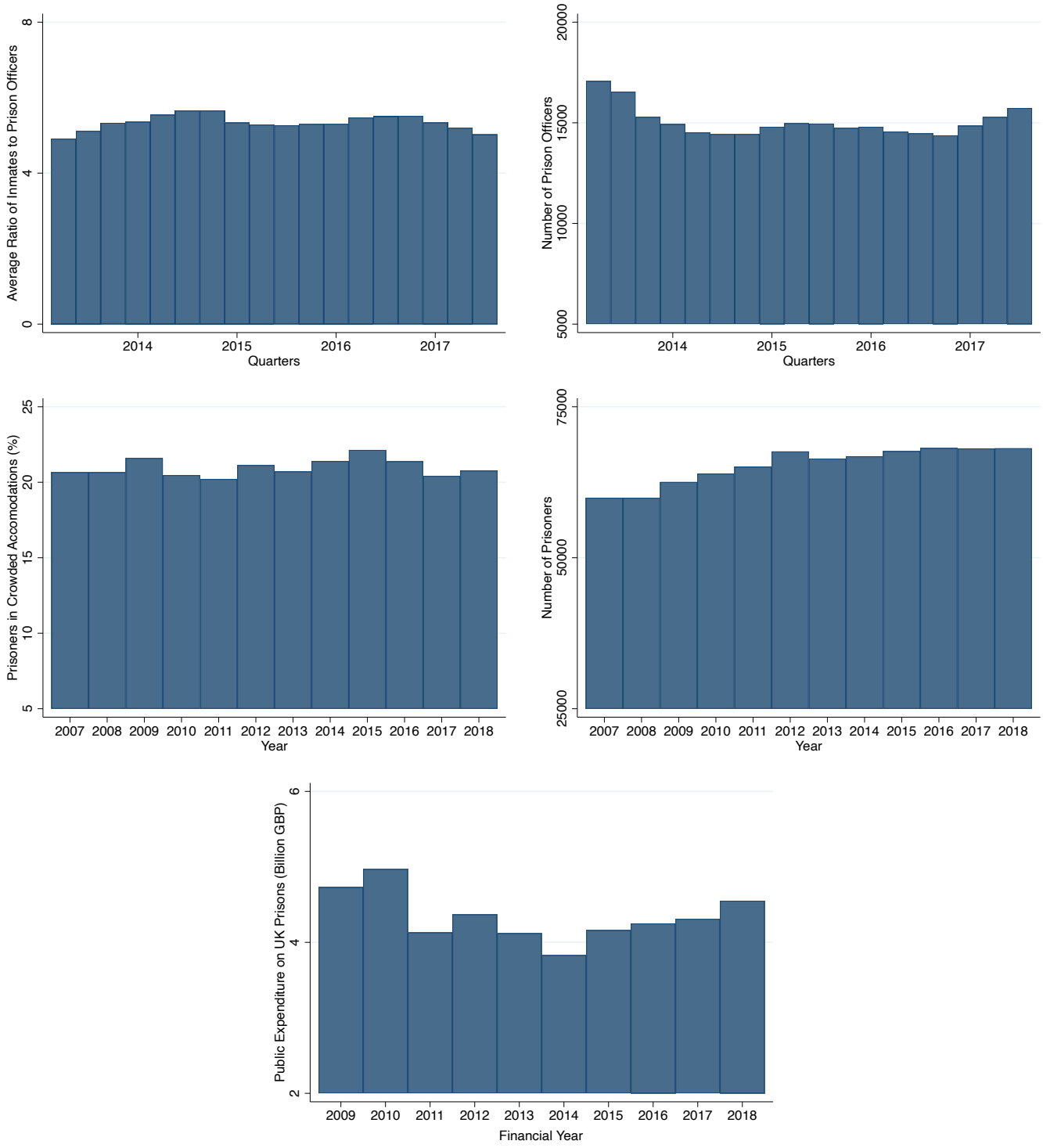
Notes: This table shows event study estimates of the impact of the Psychoactive Substances Act 2016 on an outcome displayed in the panel title. "HINPST" is an indicator variable taking the value of one if the number of NPS seizures 20 months prior to the implementation of the Act is above the corresponding median; zero otherwise. Numbers from -5 to +4 correspond to four-month periods leading and following the Act. We exclude the interaction corresponding to the period prior to the implementation (-1). The sample includes 96 prisons measured for 40 months, 20 before and 20 after the act (96×40=3,840 observations). All regressions include prison fixed effects and year-by-month fixed effects. Unless otherwise noted, standard errors displayed in parenthesis are clustered two-way at the prison and year-by-month level. Column 1 shows the baseline. Column 2 includes the number of prisoners and the percentage of prisoners in crowded accommodations. Column 3 includes prison-by-month fixed effects. Due to multicollinearity with the event study dummies we omit all pre-intervention interaction dummies. Column 4 includes prison-specific linear annual trends. Column 5 weights the regression using the number of prisoners as a weight. Column 6 shows standard errors clustered at the prison level. Column 7 displays estimates obtained from a regression where the dependent variable (y) is expressed as log(1+y). Column 8 shows results from a negative binomial count data regression. *** significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Figure A1
The Recording of New Psychoactive Substances



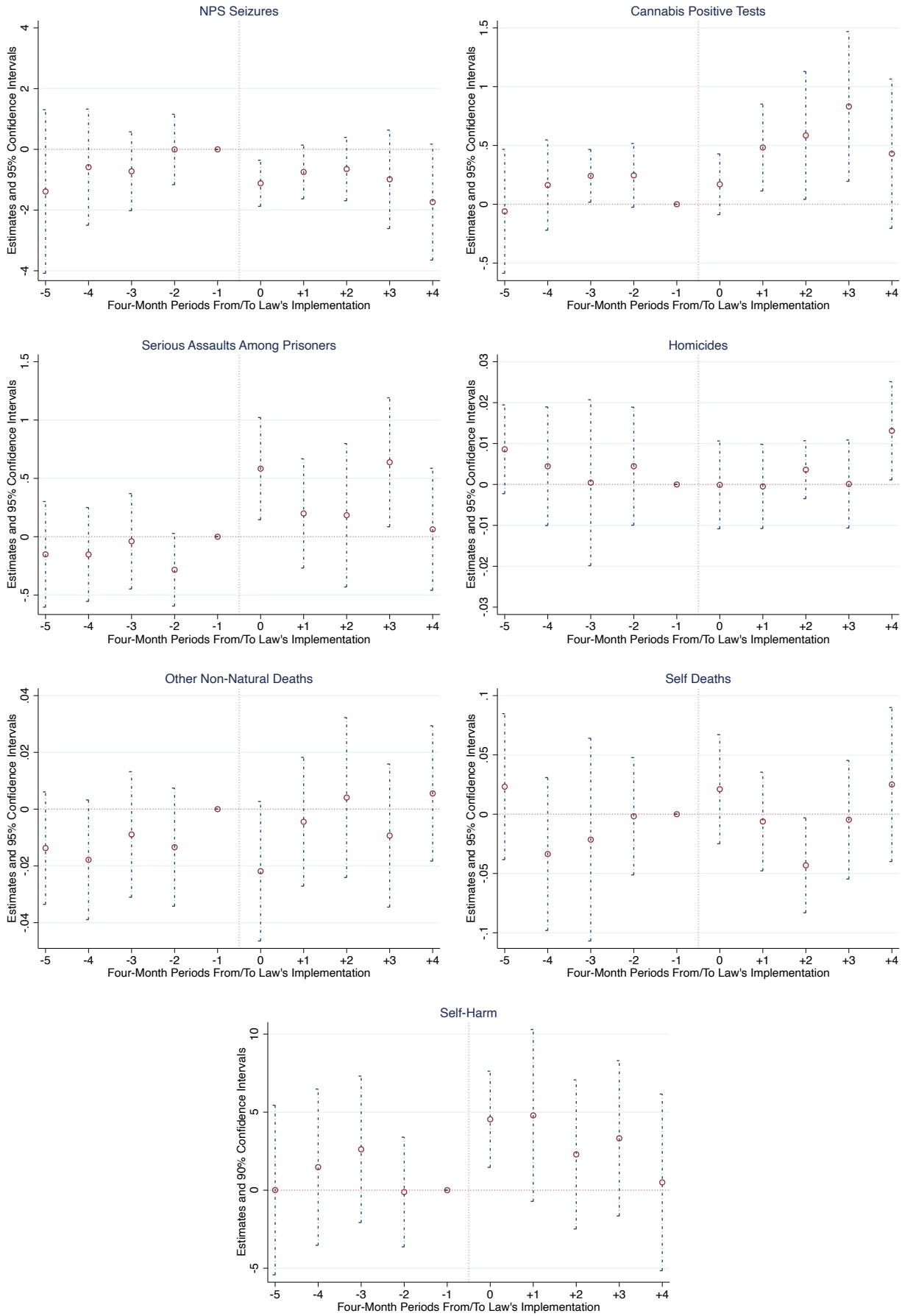
Notes: This figure shows the quarterly change in seizures of 'other', 'psychoactive', and 'unknown' substances comprising our baseline measure of NPS in England and Wales Prisons.

Figure A2
Other Patterns in England and Wales Prisons



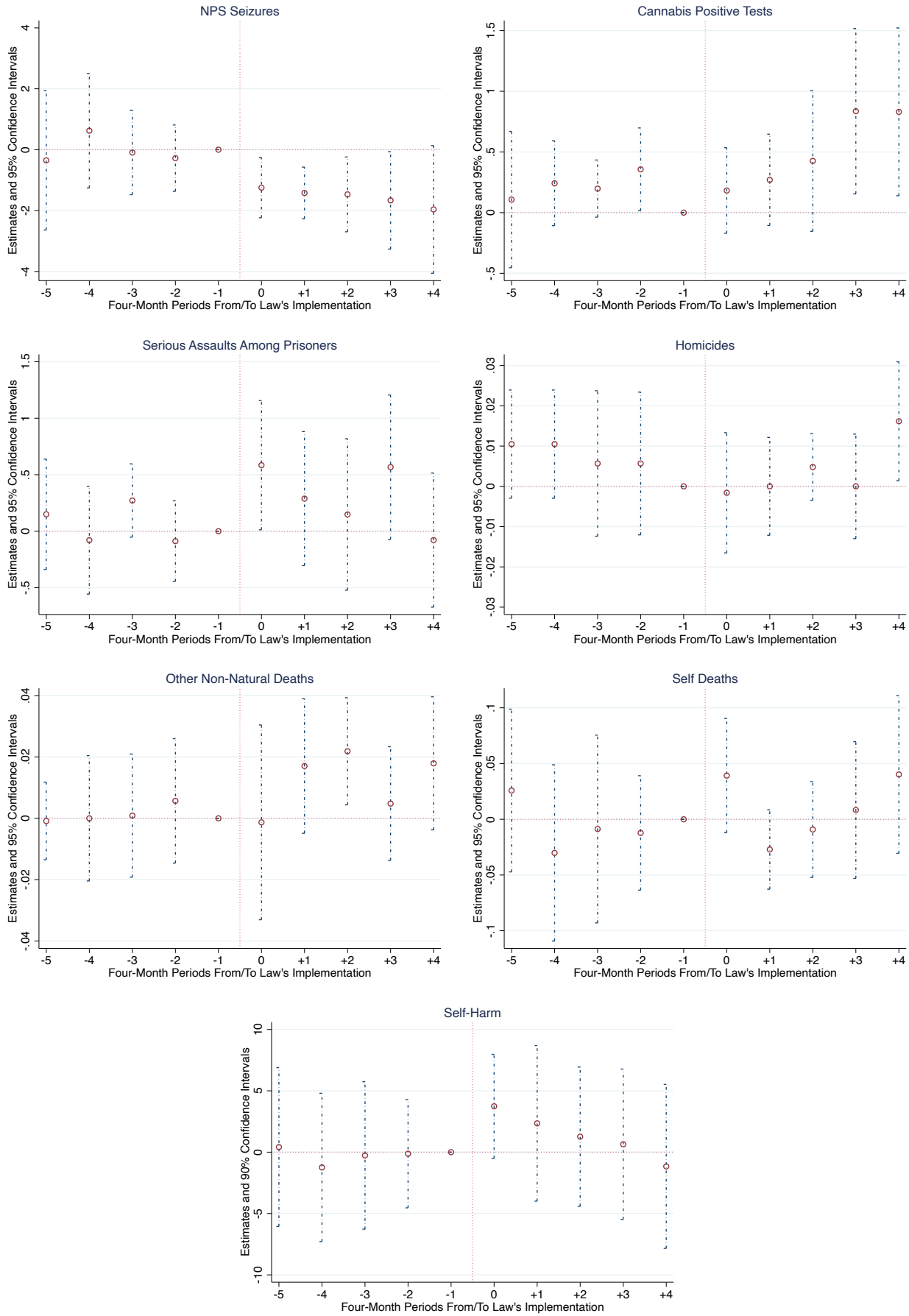
Notes: This figure shows overtime changes in the average ratio of inmates to prisoners ratio, number of prison officers, percentage of prisoners in crowded accommodations, number of prisoners, and public expenditures on UK prisons. The number of prison officers is reported quarterly. Percentage of prisoners in crowded accommodations and number of prisoners are annual averages. Public expenditures are by financial year.

Figure A3
Event Study on Main Outcomes: All prisons sample



Notes: The sample includes all 122 prisons observed from September 2014 to December 2017 (4,708 observations). The figure reports event-study estimates and confidence interval of τ obtained estimating equation (3).

Figure A4
Event Study on Main Outcomes: Excluding the Month of Implementation



Notes: The sample includes the balanced panel of 96 prisons observed from September 2014 to December 2017, excluding the month when the PSA was implemented (May 2016). Figure reports event-study estimates and confidence interval of τ obtained estimating equation (3).