

A geographical analysis of trafficking on a popular darknet market

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Abstract

Cryptomarkets are online marketplaces, located on the darknet, that facilitate the trading of a variety of illegal goods, mostly drugs. While the literature essentially focused on drugs, various other goods and products related to financial or identity fraud, firearms or counterfeit goods, as well as doping products are also offered on these marketplaces.

Through the analysis of relevant data collected on a popular marketplace in 2014-2015, *Evolution*, this research provides an analysis of the structure of trafficking (types and proportions of products, number of vendors, shipping countries). It also aims at highlighting geographical patterns in the trafficking of these products (e.g. trafficking flows, specialisation of vendors, role in the distribution chain).

The analysis of the flow of goods between countries emphasises the role of specific countries in the international and domestic trafficking, potentially informing law enforcement agencies to target domestic mails or international posts from specific countries. The research also highlights the large proportion of licit and illicit drug listings and vendors on *Evolution*, followed by various fraud issues (in particular, financial fraud), the sharing of knowledge (tutorials) and finally goods, currencies and precious metals (principally luxury goods). Looking at the country of origin, there seems to be a clear division between digital and physical products, with more specific information for physical goods. This reveals that the spatial analysis of trafficking is particularly meaningful in the case of physical products (such as illicit drugs) and to a lesser extent for digital products. Finally, the geographical analysis reveals that spatial patterns on *Evolution* tend to reflect the structure of the traditional illicit market. However, regarding illicit drugs, country-specificity have been observed and are presented in this article.

Keywords: cryptomarket ; digital traces ; NPS ; trafficking flows; illicit market; spatial analysis

1 Introduction

The Internet continues to play an important role in illegal trafficking. It acts as a facilitator, providing another medium for sales and purchases, and a platform for information sharing between users. Users can access both legal and illegal commodities online from anywhere around the world [1]. Cryptomarkets, located on the darknet, are only the last illustration of the transition from illegal markets in the real world to the virtual world [2]. Visually very similar to popular merchant websites like eBay and Amazon, cryptomarkets share several structural features with conventional online sales sites. Lists of products and services offered by sellers are organised into categories and subcategories. Sellers - and their products - are evaluated according to the feedback left by their previous customers, trust and reputation being central components of the trade on cryptomarkets [3]. Unlike conventional sales sites, however, cryptomarkets facilitate exchanges in a context where the anonymity of administrators and participants is protected thanks to the combination of encryption features. They are the connections through relays to make them anonymous (using for instance the TOR - The Onion Router - browser) [4], the automatic encryption of all communications through PGP - Pretty Good Privacy - cryptography [5] and the payments with decentralised cryptocurrencies, mainly bitcoins [6].

Considering the perpetual evolution of crime and the importance of the Internet in illicit activities, analysing any illicit market should rely on a more holistic approach and take into account the physical (i.e. traditional trafficking) as well as the virtual (i.e. online trafficking) dimensions of the market. This analysis would enable a deeper understanding of the structure of criminal groups online and potentially draw the link between the virtual world and the physical world which is not currently known. Furthermore, analysing cryptomarkets represents an interesting approach to inform on trends and dynamics that may affect the offline market. A geographical analysis would also fuel hypotheses to better understand the role of cryptomarkets as a new distribution channel, as sellers can source as well as sell drugs online. Sellers may also move their trade to sell all or part of their merchandise while producers may decide to eliminate certain intermediaries and sell directly to consumers [7]. Combining geographical analysis to general knowledge about the traditional market might highlight the presence of new actors (e.g. producers or retailers) and clarify the role played by cryptomarkets in the distribution chain. In addition, from a country-specific perspective, trends regarding different categories of product might be detected, and eventually monitored,

from both demand and supply points of view. Despite the added value of a geographical analysis, only a few studies provide a country-specific perspective and they are focused on drugs trafficking and the darknet market named Agora [8,9]. Differences in the availability of specific substances among shipping countries were observed by these research works. It was concluded that spatial specificity can be due to different factors affecting countries differently, such as geographic isolation, stringent border controls, relaxed laws in regards to illicit goods, high prices of goods, strict control of internet access, proximity to producing countries, domestic productions of goods and relative availability of illicit goods [8]. Most research on cryptomarkets has focussed on drugs to evaluate the structure of the market [2,10,11], characteristics of vendors [12–14], consumers/users' demand [15,16], the investigation of sales volume [11], vendors' activity [17], wholesale vs. retail [18] and the coherence between digital and physical information [19]. In a few words, literature shows that cryptomarkets are dominated by English-speaking countries (the United States, the United Kingdom, Australia) and Western European countries (in particular, the Netherlands) and the main offered and purchased illicit drugs are cannabis, stimulants (cocaine and amphetamines), ecstasy (MDMA) and psychedelics (NPS, LSD) [8,10,16,20].

Although drugs are offered and sold prolifically online; various illegal services and products related to financial or identity fraud as well as counterfeit goods are also offered on the cryptomarkets. To our knowledge, no information is available on the proportions these categories represent on darknet markets. In this context, this study will provide information on the types and frequencies of all the products offered on the cryptomarket Evolution. Geographic information will also be analysed to highlight specific patterns in the trafficking of certain substances or goods and reveal specificities of the illicit market for a particular country (e.g. the specialisation in the distribution of certain types of products). Such analysis will provide a comparison of the distribution of physical and digital products and help to explain the relation between the origin country and the type of product. In most studies, only the origin country is analysed. Here, a combined analysis of shipping countries and destinations will be performed to highlight trafficking flows and therefore evaluate the trafficking nature from certain countries (i.e. domestic vs. international). Lastly, the structure of illicit drugs trafficking as well as its geographic distribution will be investigated. The results will be confronted to knowledge regarding the traditional market to assess the relationship between the online and offline markets. The NPS will be specifically studied to evaluate which countries are at the forefront of the trafficking and even their role in the distribution chain. This specific example will indicate how the online trade reflect knowledge regarding the traditional trafficking.

2 Dataset and methodology

The cryptomarket Evolution was studied since it was a popular cryptomarket during its period of activity, from January to March 2015¹. In particular, it was very attractive to users since it survived “Operation Onymous” in late 2014 [21]. The dataset used in this study is a compilation of source codes collected, gathered and released by an independent researcher named Gwern Brawn². He performed data collection over 115 days between January 2014 and March 2015. Although the data is not exhaustive as the crawling was not conducted every day and the pages that presented an error were not downloaded, the crawls were frequent enough (weekly) and millions of pages were downloaded by the researcher [22]. As a consequence, the dataset used in this study can be considered representative for the purpose of the research.

This dataset has already been used in a previous research in order to provide an overview of Evolution in an attempt to test the reliability of vendors' listings by purchasing illicit drugs and analysing them [19]. The present research is not only focused on drugs related listings but on all goods offered on Evolution. Each listing of every category was parsed by the authors through a Python script to extract its title, price and classification within the cryptomarket, as well as the vendor pseudonym and the geographical information - i.e. the mentioned shipping country and destination(s). Vendor username was used to evaluate the total number of vendors present on a cryptomarket as well as the product category where vendors were the most present [11,17]. Trafficking flows between countries were also obtained using country of origin and destination country. Section 3.5 deals with the evaluation of the role of countries within the distribution chain of NPS. For this purpose, the quantity and price of the offered products were investigated for each listing. All information was structured to allow further analysis and to accurately study the trafficking structure on Evolution. A new classification of listings was carried out. Indeed, the overview of the worldwide market would otherwise be uncertain and specific patterns (predominance of a product category, specific spatial distribution, etc.) could also be unclear or even hidden (see Appendix 1 for details about the new classification we performed), as also observed by other researchers [8,9,18,22].

Data analysis was performed using R [23], RStudio v. 1.0.136, Tableau Software Professional Edition v. 9.3 and Microsoft

¹ It is assumed that the administrators of Evolution “exit scammed” (DeepDotWeb, 2015)

² Data available on the Reddit page <https://reddit.com/2zllmv>

Excel v. 15.31. Trafficking flows (section 3.3) were represented as chord diagrams using the R library *circlize*³. Only for this particular analysis, listings with unstated shipping destinations were removed (n = 40,851).

3. Results and discussion

3.1. Products offered

The extraction of each listing source code for every crawling date led to the identification of 92,980 unique sale proposals, after discarding six listings that stated unclear shipping country information. A total number of 4,171 distinct vendor usernames was detected. Results show that a vendor may manage one or more listings (min = one listing, max = 1,441, median = 9, mean = 22, standard deviation = 49). Most of the sale proposals (63%) concern licit or illicit drugs and paraphernalia, in particular, illicit drugs (close to 50% of all listings), as illustrated in Table 1 below. This is also the sub-category where vendors are the most present (close to 60% of vendors offer at least one product classified as illicit drug). Specific trends concerning the distribution of illicit drugs will be discussed in the section 3.5. This category also includes prescription drugs and medicines (mainly benzodiazepines - 34% and synthetic opioids - 31%), performance and image enhancing drugs (PIEDs, mainly steroids) as well as, to a lesser extent, laboratory supplies and paraphernalia. Listings related to various fraud issues represent almost a third of the total number of listings and close to half of vendors propose products classified in this category. Several activities and services related to carding⁴ are particularly covered (listings classified as carding represent close to 70% of the listings grouped in “Fraud Related”). Goods with a high probability of forgeries are mainly concerned in the third category “Goods, currencies and precious metals”. Indeed, luxury goods (essentially watches - 89%) and clothes and accessories (glasses - 21%, bags - 18% and shirts - 14%) represent about 60% of the sale proposals in this category. Interestingly, only a few vendors offer goods in these two categories. The “ID Related” category includes sale proposals related to ID theft (37%), various types of licences and legitimization documents such as bank statements or university diplomas (35%) and IDs (28%). ID theft mainly consists in “fullz”, as advertised by vendors, that are archives containing financial information (bank account logins or credit card numbers) and personal information (name, address, e-mail, security social number, date of birth, mother’s maiden name, etc.). According to the listing titles, the IDs subcategory includes scans of ID cards or passports, editable graphical material as well as genuine or forged IDs. Lastly, about 1,000 listings were classified as “Firearms & Weapons” in which a third of sale proposals concerns firearms.

³ <https://cran.r-project.org/web/packages/circlize/index.html>

⁴ Carding concerns the acquisition (through skimmers at ATMs or hacking an e-commerce, for instance) and resale of credit cards and bank accounts as well as related activities such as money laundering (e.g. money transfer using bitcoins, money transfer companies or acquisition of prepaid cards) or reshipping services through mules.

Category	Listings (%)	Vendors (%)*
ILLCIT DRUGS, DRUGS AND PARAPHERNALIA	63	69
Illicit drugs	46	57
<i>Cannabis</i> *	39	52
<i>Ecstasy & MDMA</i> *	19	31
<i>NPS</i> *	10	17
<i>ATS</i> *	9	21
<i>Cocaine</i> *	8	25
<i>LSD and derivatives</i> *	5	11
<i>Opioids</i> *	4	11
<i>NPS - Other</i> *	2	8
<i>NPS – Synthetic cannabinoid</i> *	1	2
<i>Other</i> *	3	12
Prescription drugs and medicines	14	25
Performance and Image Enhancing Drugs	2	3
Lab supplies and paraphernalia	1	4
VARIOUS FRAUD ISSUES	30	44
Fraud related	13	32
Guides and tutorials	10	18
Goods, currencies and precious metals	4	9
<i>Luxury goods</i> *	46	9
<i>Currencies and precious metals</i> *	21	44
<i>Electronic devices</i> *	18	55
<i>Clothes and accessories</i> *	15	6
ID related	3	11
Firearms and weapons	1	4
OTHER	7	30
Custom listings	26	26
Miscellaneous	9	9

Table 1. Listings' and vendors' proportions for the different categories of products. Listing/Vendor percentages are calculated as the ratio between the respective number of listings/vendors for each product main categories and the respective total number of listings/vendors in the whole market (n = 92,980 listings and 4,171 vendors).

* : Since a same vendor account may manage listings classified in different (sub-)categories, the number of vendors may be higher than the total number of vendors calculated according to their usernames.

★ : Listing/Vendor percentages of subcategories are calculated as the ratio between the respective number of listings/vendors for each subcategory and the total number of listings/vendors of the main category.

ATS : Amphetamine Type Substances (Amphetamine and Methamphetamine)

3.2. Shipping countries

On Evolution, vendors may inform on the shipping country and destination(s) of their products by selecting countries/regions from a preset list. According to our dataset, 93 shipping countries and 164 shipping destinations have been mentioned (see Appendix 2 Table B1). On a given sale proposal, vendors always mentioned one shipping country only, while a list of destination countries was sometimes stated. Vendors may manage several listings. A combined study of vendor usernames and shipping countries shows that vendors may state different shipping countries between their sale proposals, even though they mostly mention only one shipping country (see Figure 1).

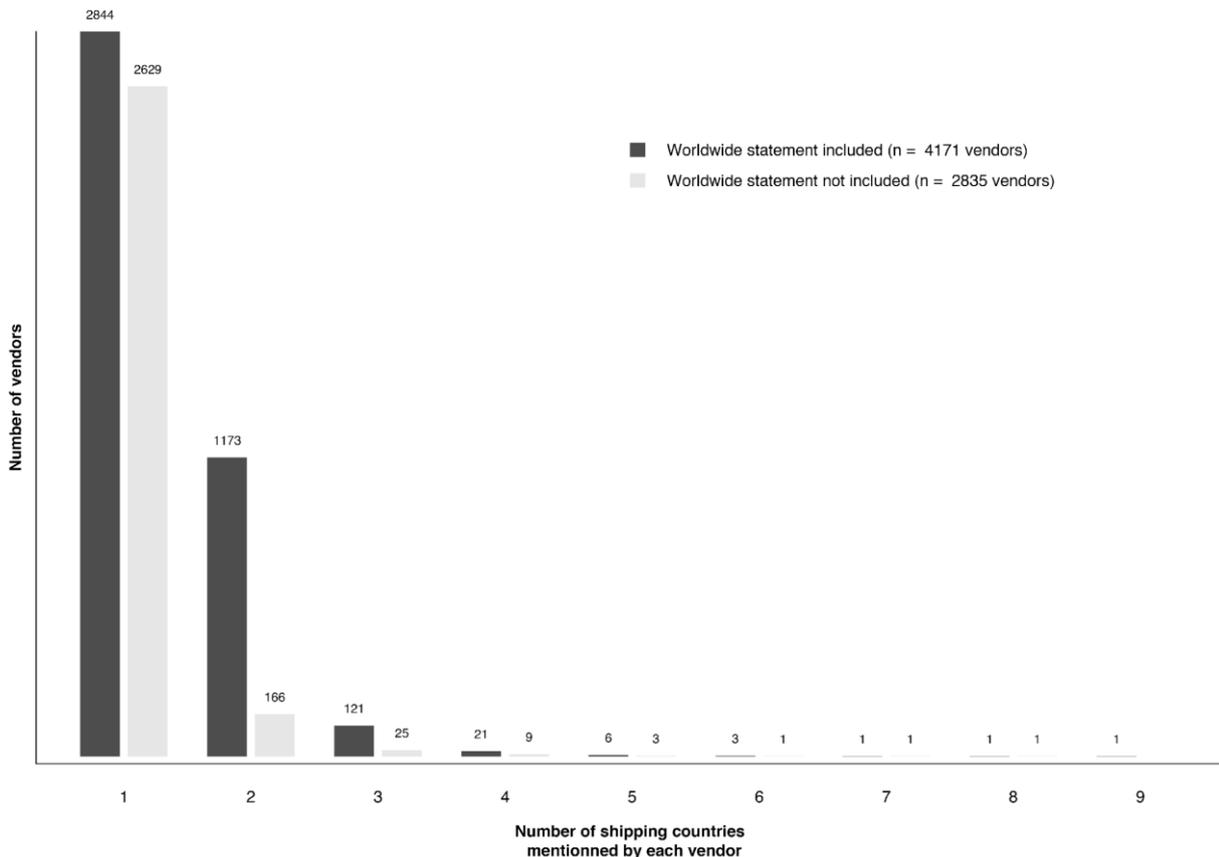


Figure 1. Number of vendors mentioning one or more shipping countries in their sale proposals

An analysis of the frequency of shipping countries indicates that “Worldwide” was mentioned by close to 50% of all vendors and stated in close to 40% of all listings. The predominance of this statement may be seen as a limitation for a valid assessment of the trafficking magnitude of specific countries when analysing the global market. Indeed, this high proportion implies that we may underestimate the position of a specific country in the market. However, we may also assume that vendors from any country may choose to indicate “Worldwide”. In this case, the proportions may be quite accurate. Interestingly, stating “Worldwide” depends on the nature of the product proposed by vendors, as shown in Table 2. There is a clear division between digital and physical products. For instance, hacking services or material related to financial fraud (“Fraud related” category), manuals (“Guides and tutorials”) and scans of IDs or legitimization documents (“ID related”) are digital products. Instead, counterfeit goods (“Goods, currencies and precious metals”), chemicals (“Lab supplies and paraphernalia”) or any type of drugs (“Prescription drugs and medicines, PIED and Illicit drugs”) are physical. The origin country does not represent a meaningful information for digital goods that are sent through the Internet, which may explain the high proportion of vendors selecting “Worldwide” as the shipping country. To the contrary, the delivery mode of physical material makes it possible to check the coherence between the origin country stated online and that written down on the postal parcel. Therefore, vendors may not have interest to provide incorrect information since customers may leave negative

feedbacks in the case of inaccurate data [8]. This would explain why vendors mainly provide a meaningful shipping country when offering physical products and do not utilise the “Worldwide” statement. Vendors still stating their physical products as shipped from “Worldwide” may like to conceal the true origin of their merchandise or they prefer to provide details in the description part of the listing. Thus, the spatial analysis of trafficking on cryptomarkets is particularly meaningful in the case of physical products and to a lesser extent for digital products.

Category	Listings (%)	Vendors (%)
Fraud related	90	88
Guides and tutorials	87	94
ID related	86	86
Miscellaneous	67	58
Firearms and weapons	34	55
Goods, currencies and precious metals	27	65
Lab supplies and paraphernalia	24	38
Prescription drugs and medicines	18	32
Performance and Image Enhancing Drugs	17	34
Illicit drugs	15	37

Table 2. Listings and vendors’ proportions where “Worldwide” was mentioned as the origin country for each product category

Country/Region	Listings (%) (n = 92,980)	Vendors (%)* (n = 4,171)
Worldwide	38.6	62.4
United States	18.6	26.1
United Kingdom	8.9	10.8
Germany	6.5	6.8
Netherlands	6	5.1
Australia	4.5	5.8
China & Hong Kong SAR China	3.6	1.2
Canada	2.9	3.8
Sweden	2	2.3
Belgium	1.6	0.7
France	1.5	2.2

Table 3. Proportion of listings and vendors for the shipping countries having at least 1% of the total number of listings

* : Since vendors may mention different shipping countries between their listings, the sum of percentages is higher than 100%.

Without considering “Worldwide”, the analysis of the stated origin countries shows the dominant position of English speaking countries (the United States, the United Kingdom and Australia) and Western European countries (Germany and Netherlands) which was also observed in [20] (see Table 3). Although since 2013, several non-English language markets have appeared, English seems to remain the dominant language. This might be a result of the central position of English-speaking countries in online trades or the fact that English is usually the trading language which might deter non-English vendors from offering goods [20]. It is worth noting that while some countries have similar proportions of both listings and vendors (the United Kingdom, Germany or Sweden, for instance), the listing proportions of China & Hong Kong are three times higher than their respective vendor proportions. This clearly reveals a specificity of their market structure: a few vendors are involved but they manage a large number of listings. Since each listing may be purchased several times by customers, this result may indicate that vendors have stock and thus have access to a steady long-term supply of the products they offer. The small number of Chinese vendors may be explained by the very strict control of China’s Internet traffic [24]. In addition, trafficking on online darknet platforms might not be considered as effective for Chinese vendors for various reasons. Indeed, the registration process on the darknet markets (e.g. fees, access constraints, etc.) may be considered by Chinese vendors as too restrictive, urging them to adopt other ways of distribution such as dedicated websites on the clear web. Thus, the clear web may be the main reason explaining the relatively minor position of the Chinese market on the darknet, since it represents an efficient method for the distribution of products in which Chinese vendors specialise, as it will be discussed further below (see sections 3.4 to 3.6). 234

3.3. *Trafficking flows*

A combined analysis of shipping countries and destinations was performed to evaluate the nature of trafficking for the main countries (see Figure 2). First, Figure 2 clearly shows the distinction between physical (e.g. illicit drugs) and digital (e.g. ID related) goods discussed above. The “Worldwide” origin is much more mentioned for ID related goods than for illicit drugs (see Table 2 and Figure 2).

In addition, such analysis reveals the behaviour of vendors and the market dynamics for each country, and reciprocally. Interestingly, the flow of illicit drugs is essentially domestic in Australia (i.e. Australian sellers only propose products to customers living within the country) or mainly in the United States. The domestic pattern may be explained by the intent of both customers and vendors to reduce their risks (such as parcel loss, interception by authorities or arrest) by selling or purchasing only within their country of residence [25]. Accordingly, Kruihof et al. [20] mentioned that many vendors appear to be reluctant to ship to countries with stricter law enforcement and border controls such as Finland, Australia, the United States and Canada. By contrast, Germany, Canada and the Netherlands mainly export internationally. This may be related to the role of these countries in the production of synthetic drugs, such as Ecstasy & MDMA and amphetamines (see section 3.5) [26,27]. In the same line, a relative easy access to illicit drugs in the domestic market would not stimulate local users to purchase substances on cryptomarkets and would motivate sellers to export to foreign customers [25]. A more competitive domestic market from vendors’ point of view would have the same consequence. The analysis of trafficking flows also helps to understand and explain the offer patterns. For instance, if a domestic market is observed, we may expect good correlation between the types and frequencies of products offered and the prevalence data of the local population (or at least, the sub-population sourcing drugs on cryptomarkets) (see section 3.5).

In an intelligence perspective, the identification of an important domestic market such as the one in Australia or the United States may encourage a tighter control of mails inside the country. The determination of the main countries that export internationally (e.g. China, the Netherlands or Germany) may help to target posts from these specific countries. Furthermore, combining the trafficking flows information to the types of good and the concealment methods indicated by sellers online, which tends to match that of the delivered packages [19], may be of added value and could help targeting specific types of packages from specific countries.

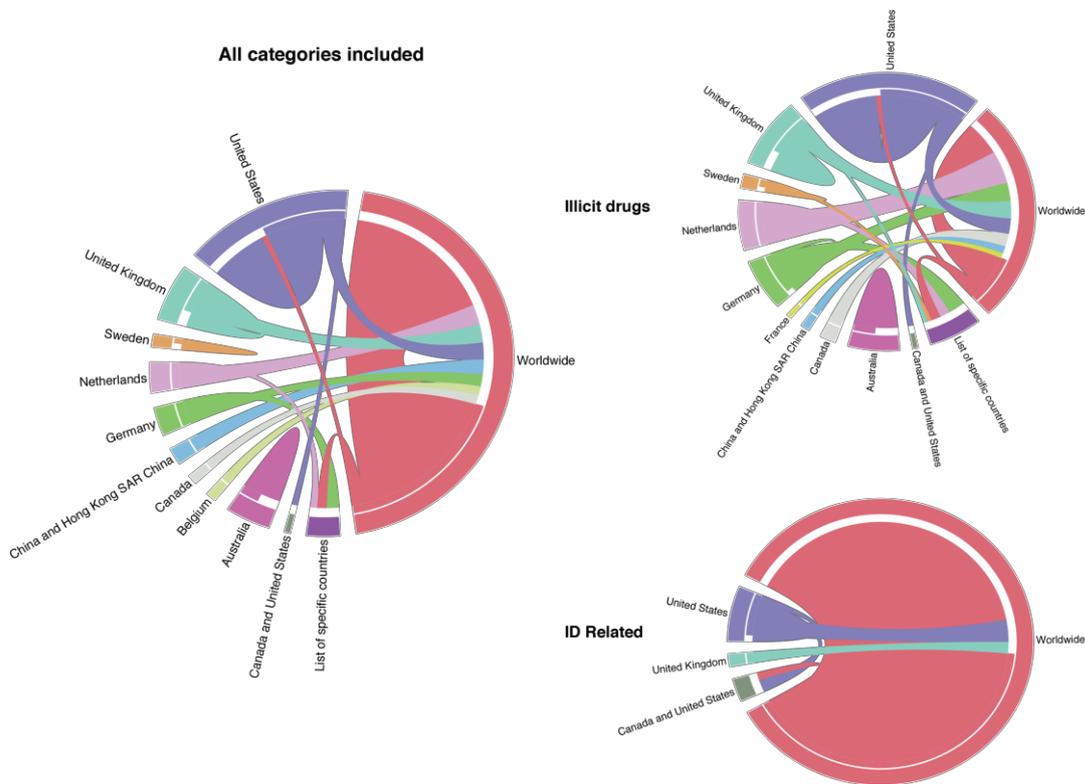


Figure 2. Structure of trafficking considering the whole market (left) and two categories of physical (top right) and virtual products (bottom right). The circular plot shows the directional flows (origin and destination) of products for the most frequent couples of origin and destination countries (i.e. couples having a frequency of at least 1% in relation to the total number of existing combinations)⁵

3.4. Spatial specificity

To evaluate the specialisation of vendors from any country and their respective importance in the trafficking of products, the distribution of listings and vendors for every country was analysed (Figures 3 and 4) as well as their contribution to the total number of listings for each product category (Figure 5). For instance, Figure 3 indicates that illicit drugs and prescription drugs

represent respectively 66.3% and 18.5% of all listings (when worldwide is excluded). We also observe that 64% and 6.5% of the listings “from” respectively American and Indian vendors concern illicit drugs. They are respectively managed by 710 and 8 vendors (see Figure 4). Lastly, the analysis of Figure 5 shows that the United States accounts for 30% of all sale proposals on Evolution (worldwide excluded). Moreover, vendors from the United States - in line with their number (see Figure 4) - are the main contributors on Evolution since they dominate the distribution of illicit drugs (29.2% of listings classified in the category are managed by “American” vendors), prescription drugs (41.6%), fraud related (30.4%), lab supplies (48.1%) and ID Related (59.1%).

⁵ The origins and destinations of products are represented by the circle’s segments. A specific color is assigned to the flows and circle’s segments of a particular country. The size of the flow is indicated by the width of the link and its basis. The direction of the flow is encoded both by the origin color and by the gap between link and circle segment at the destination. The direction goes from a non-gap to a gap. Listings with unstated shipping destinations were removed from the analysis (n = 40,851).

Origin country	Illicit drugs	Prescription drugs and medicines	Goods, currencies and precious metals	Performance-enhancing drugs	Fraud Related	Guides & Tutorials	Lab supplies & Paraphernalia	Firearms & Weapons	ID Related	Total
Australia	66.0%	15.1%	1.0%	8.0%	3.1%	0.2%	2.8%	3.6%	0.3%	100.0%
Belgium	35.4%	6.9%	1.5%	0.1%	2.2%	54.0%	0.1%			100.0%
Canada	85.3%	12.0%	0.2%	1.1%	0.3%	0.0%	0.6%	0.2%	0.2%	100.0%
China & Hong Kong SAR China	35.2%	6.3%	54.9%	0.8%	1.1%	0.4%	0.6%	0.6%		100.0%
France	74.0%	9.4%	4.5%	0.1%	4.2%	3.7%		2.8%	1.4%	100.0%
Germany	80.5%	11.8%	0.8%	1.4%	1.8%	0.2%	0.4%	3.0%	0.2%	100.0%
India	6.5%	91.6%	0.4%	1.3%			0.2%			100.0%
Netherlands	93.5%	4.2%	0.5%	0.2%	0.7%	0.0%	0.4%	0.3%	0.1%	100.0%
Spain	69.7%	26.8%	0.9%	0.3%	1.1%		0.3%	1.0%		100.0%
Sweden	48.9%	44.6%	0.1%	0.6%	0.2%	0.1%	2.8%	2.8%		100.0%
United Kingdom	64.5%	20.5%	2.0%	4.6%	3.8%	1.6%	2.2%	0.1%	0.9%	100.0%
United States	64.0%	25.5%	1.3%	1.4%	2.2%	0.8%	2.5%	0.9%	1.3%	100.0%
Other country*	56.4%	17.9%	3.6%	14.1%	3.8%	0.4%	0.9%	2.2%	0.8%	100.0%
Total	66.3%	18.5%	4.6%	2.9%	2.2%	2.1%	1.6%	1.3%	0.7%	100.0%

Figure 3. Distribution of listings in product categories for every shipping country (without considering the worldwide statement). * Country with less than 1% of the total number of listings

Origin country	Illicit drugs	Prescription drugs and medicines	Goods, currencies and precious metals	Performance-enhancing drugs	Fraud Related	Guides & Tutorials	Lab supplies & Paraphernalia	Firearms & Weapons	ID Related	Total
Australia	193	73	16	18	26	7	18	10	6	239
Belgium	26	7	3	1	2	1	1			30
Canada	135	48	3	3	4	1	6	1	2	159
China & Hong Kong SAR China	25	21	13	3	4	2	6	1		50
France	60	12	8	1	16	6		9	7	88
Germany	211	71	17	10	30	6	7	19	5	274
India	8	10	2	2			1			20
Netherlands	193	27	9	1	14	2	7	6	3	210
Spain	40	12	2	1	1		1	1		49
Sweden	73	41	1	3	3	1	6	8		93
United Kingdom	317	131	31	17	67	18	18	6	21	444
United States	710	441	67	27	131	36	58	31	38	1 078
Other country*	207	93	29	17	34	6	8	12	11	301
Total	2 070	932	192	102	315	84	132	101	90	2 806

Figure 4. Number of vendors for each shipping country and product categories.

* Country with less than 1% of the total number of listings

Figures 3 and 4 highlight the specialisation in prescription and illicit drugs of vendors from the Netherlands (98% of listings and 93% of vendors), Canada (97% each), Spain (96% and 94%) or Sweden (94% each). The specialisation of ‘Dutch vendors’ has also been observed by a study based on more recent datasets that concluded that they use cryptomarkets almost exclusively for drug sales and particularly ecstasy-type drugs and stimulants [20]. The specialisation of Indian vendors in the distribution of prescription drugs (see Figure 3) is also worth to be highlighted, especially when considering the small number of vendors they represent, compared to that of the other countries present in the category (see Figures 4 and 5). This was also observed on the cryptomarket Agora [9]. By contrast, sellers ‘from’ Australia, Germany, the United Kingdom or the United States seem to diversify their activities. In line with their number of vendors (see Table 3) they are predominant in each of all categories (Figure 4), which is also corroborated by the study of the origin of listings for each category (Figure 5). In fact, these four countries together dominate the distribution of products in the majority of categories, such as illicit drugs (about 77% relative to the total number of listings of the category), prescription drugs (73%), PIEDs (63%), fraud related (77%), lab supplies (86%), firearms (71%) and ID related (86%). ‘Guides and Tutorials’ and ‘Goods, currencies and

precious metals” are the only two categories where vendors from these countries are not predominant. “Guides and Tutorials” has been flooded by one Belgian vendor who is responsible of 68% of listings in the category.

Origin country	Illicit drugs	Prescription drugs and medicines	Goods, currencies and precious metals	Performance-enhancing drugs	Fraud Related	Guides & Tutorials	Lab supplies & Paraphernalia	Firearms & Weapons	ID Related	Total
Australia	7.0%	5.7%	1.5%	19.5%	9.9%	0.8%	12.4%	20.0%	3.5%	7%
Belgium	1.4%	1.0%	0.8%	0.1%	2.6%	67.8%	0.1%			3%
Canada	6.1%	3.1%	0.2%	1.9%	0.7%	0.1%	2.0%	0.6%	1.4%	5%
China & Hong Kong SAR China	3.2%	2.1%	71.8%	1.8%	3.0%	1.1%	2.4%	3.0%		6%
France	2.7%	1.2%	2.4%	0.1%	4.6%	4.3%		5.5%	5.1%	2%
Germany	13.0%	6.8%	1.9%	5.1%	8.5%	1.0%	2.8%	25.4%	3.0%	11%
India	0.1%	4.2%	0.1%	0.4%			0.1%			1%
Netherlands	13.9%	2.2%	1.1%	0.7%	3.2%	0.2%	2.4%	2.0%	1.4%	10%
Spain	1.3%	1.8%	0.2%	0.1%	0.7%		0.2%	1.0%		1%
Sweden	2.4%	7.8%	0.0%	0.6%	0.2%	0.1%	5.8%	7.3%		3%
United Kingdom	14.3%	16.2%	6.3%	23.4%	25.2%	11.1%	20.1%	1.2%	19.0%	15%
United States	29.2%	41.6%	8.5%	14.5%	30.4%	12.2%	48.1%	22.8%	59.1%	30%
Other country*	5.5%	6.3%	5.1%	31.9%	11.1%	1.3%	3.6%	11.2%	7.6%	6%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Figure 5. Contribution (in terms of listing proportions) of each shipping country in product categories (without considering the worldwide statement). * Country with less than 1% of the total number of listings

The “Goods, currencies and precious metals” category seems to be controlled by Chinese vendors (71.8% of the listings, see Figure 5), while their number (13) is lower than other countries present in the category such as the United States (67), the United Kingdom (31), Germany (17) and Australia (16) (see Figure 4). In particular, they manage almost 99% of all listings classified as “Luxury goods”, which mainly consist in watches & jewellery, and 85% of that classified as “Clothes and accessories”. Most of the listing titles mention luxury brands, contain the term “replica” and are sold at cheap prices. For instance, concerning watches ($n = 1'347$ listings), Rolex is the most proposed brand ($n = 314$) followed by Omega ($n = 217$), Emporio Armani ($n = 197$), Breitling ($n = 172$) and Audemars Piguet ($n = 149$) and their prices range from 50 to 200 USD. Overall, all watch brands but one (Emporio Armani collection of the Giorgio Armani industry) are affiliated to the Federation of the Swiss Watch Industry (FH), according to its official website⁶. These results are consistent with the few sources of information regarding the trafficking of luxury goods [28].

The evaluation of the impact of countries in the trafficking of specific products as well as their role in the distribution chain was found to be particularly relevant in the case of illicit drugs and is therefore developed in the following section. Indeed, they represent the main good offered (see Table 1) as well as the category where Worldwide is less stated (see Table 2 and Figure 2).

3.5. Illicit drugs

As mentioned in the introduction, English-speaking countries (e.g. the United States, the United Kingdom, Australia) and Western European countries (e.g. the Netherlands) dominates the trafficking of illicit drugs on cryptomarkets while cannabis, stimulants (cocaine and amphetamines), ecstasy (MDMA) and psychedelics (NPS, LSD) are the main drugs offered on cryptomarkets. In addition, compared to the traditional market, the relative low offer and purchase of substances such as cocaine and heroin was noted by Kruihof et al. (2016). This may be the consequence of the predominance of recreational consumers or psychonauts on cryptomarkets [14,29,30]. The elements of planning and having to wait for delivery which characterised cryptomarkets might deter excessive consumers or the ones not able to plan their consumption [12,20]. This may be the case of regular cocaine and heroin consumers, which may have timely access to their substances through traditional means of supply (street dealer, contacts). These observations are further emphasised in our study (see Figures 6-8).

Similarly to the previous section, Figures 6, 7 and 8 provide information about the distribution of illicit drug listings and vendors for every country (Figures 6 and 7) and their contribution to the total number of listings for each category of illicit drugs (Figure 8).

Origin country	Cannabis	Ecstasy & MDMA	NPS	Cocaine	Amphetamine	LSD and derivatives	Opioids	Methamphetamine	Other	Total
Australia	19.4%	21.9%	10.1%	10.1%	3.4%	5.0%	4.4%	19.1%	6.4%	100.0%
Canada	50.0%	14.0%	11.6%	5.6%	1.5%	4.2%	3.1%	2.5%	7.4%	100.0%
China & Hong Kong SAR China	0.3%	1.4%	93.3%						5.1%	100.0%
France	49.9%	16.8%	4.3%	5.9%	3.9%	2.8%	15.4%	0.7%	0.3%	100.0%
Germany	37.6%	31.7%	2.9%	6.0%	10.5%	4.5%	1.8%	1.8%	3.2%	100.0%
Netherlands	17.4%	43.8%	5.3%	10.5%	9.8%	4.1%	3.5%	0.4%	5.3%	100.0%
Sweden	33.8%	24.8%	4.2%	5.1%	22.8%	5.5%	0.7%	0.5%	2.7%	100.0%
United Kingdom	38.2%	17.1%	10.4%	12.1%	3.9%	5.4%	6.4%	2.0%	4.5%	100.0%
United States	53.2%	8.9%	9.7%	6.9%	0.3%	5.0%	4.7%	5.2%	6.1%	100.0%
Other Country*	44.6%	16.7%	8.3%	8.3%	5.5%	3.7%	4.9%	2.7%	5.4%	100.0%
Total	38.6%	20.1%	10.7%	8.0%	4.8%	4.5%	4.3%	3.8%	5.1%	100.0%

Figure 6. Distribution of illicit drug listings for every shipping country (without considering the worldwide statement).

* Country with less than 2% of the total number of illicit drugs listings

Origin country	Cannabis	Ecstasy & MDMA	NPS	Cocaine	Amphetamine	LSD and derivatives	Opioids	Methamphetamine	Other	Total
Australia	59	78	43	42	15	14	17	66	34	193
Canada	75	37	17	26	7	13	19	11	33	135
China & Hong Kong SAR China	1	4	22						9	25
France	43	16	8	16	5	7	9	3	2	60
Germany	124	97	16	54	76	21	14	13	29	211
Netherlands	69	108	30	74	55	26	20	5	39	193
Sweden	41	23	7	11	22	8	2	2	7	73
United Kingdom	160	95	83	100	20	37	42	19	59	317
United States	359	146	115	121	16	77	83	80	105	710
Other Country*	160	62	40	65	40	32	24	20	42	273
Total	1 060	642	363	495	248	227	219	211	353	2 070

Figure 7. Number of vendors for each shipping country and categories of illicit drugs.

* Country with less than 2% of the total number of listings

Most countries propose cannabis related products which is also the illicit drug mainly offered (38.6%) of all illicit drug listings (see Figures 6 and 7). In addition to the adaptation to the customer demand, the predominance of cannabis may be explained by the easy access to cannabis. Indeed, cannabis is not only the most consumed drug worldwide, it also represents the most widely cultivated drug crop according to the UNODC [26]. Among the main stated countries, Australia, China and the Netherlands are the only ones that do not mainly propose cannabis. For instance, vendors from Australia propose at similar frequencies Ecstasy & MDMA, cannabis and methamphetamine, which is tightly related to the indicators of the traditional market (arrests, seizures and prevalence data) according to the Australian Intelligence Crime Commission [31]. We may reasonably assume that such trend is the consequence of the domestic pattern observed for the Australian illicit drug trafficking (see Figure 2). Lastly, the high proportions of listings of Ecstasy & MDMA and amphetamine from Dutch vendors, and to a lesser extent from German vendors (see Figure 6), can be explained by the main role these countries play in the production of such drugs [27]. As shown in Figure 8, together they cover more than half of the sale proposals of both Ecstasy & MDMA (50.7% of all listings in the category) and amphetamine (56.8%). Concerning Ecstasy & MDMA, while production is now global, Europe, in particular the Netherlands, is considered as the world’s leading source of the drug [32]. Clear spatial specificity can be observed for amphetamines, which are mainly proposed by Germany, the Netherlands and even Sweden (Figure 6) and methamphetamine, which is mainly offered by Australia and the United States.

Origin country	Cannabis	Ecstasy & MDMA	NPS	Cocaine	Amphetamine	LSD and derivatives	Opioids	Methamphetamine	Other	Total
Australia	3.5%	7.6%	6.6%	8.9%	5.0%	7.8%	7.1%	34.9%	8.7%	7%
Canada	8.0%	4.3%	6.6%	4.3%	1.9%	5.8%	4.3%	4.1%	8.8%	6%
China & Hong Kong SAR China	0.0%	0.2%	27.7%						3.1%	3%
France	3.5%	2.3%	1.1%	2.0%	2.2%	1.7%	9.6%	0.5%	0.2%	3%
Germany	12.6%	20.4%	3.5%	9.7%	28.5%	13.0%	5.4%	6.0%	8.0%	13%
Netherlands	6.2%	30.3%	6.8%	18.2%	28.3%	12.5%	11.3%	1.3%	14.2%	14%
Sweden	2.1%	3.0%	0.9%	1.5%	11.4%	2.9%	0.4%	0.3%	1.3%	2%
United Kingdom	14.1%	12.2%	13.9%	21.6%	11.5%	17.0%	21.2%	7.3%	12.5%	14%
United States	40.3%	12.9%	26.5%	25.1%	1.7%	32.6%	31.4%	39.9%	34.5%	29%
Other Country*	9.6%	6.9%	6.4%	8.7%	9.5%	6.8%	9.4%	5.8%	8.7%	8%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Figure 8. Contribution (in terms of listing proportions) of each shipping country in illicit drug categories (without considering the worldwide statement). * Country with less than 2% of the total number of illicit drugs listings

Amphetamine is still mainly produced in Europe while methamphetamine production is limited to the Baltic region and Central European countries. Moreover, the use of methamphetamine in Europe is limited compared to that of amphetamine and is restricted to a group of geographically close countries [33]. By contrast, as noted in the last World Drug Report [26], « although methamphetamine is a feature of ATS markets worldwide, it is particularly dominant in East and South-East Asia and North America ». In Australia, methamphetamine remains the main drug produced in clandestine laboratories detected [31]. Finally, the United States are responsible for the main proportion of illicit drug listings (29%), concentrate the largest number of vendors (more than twice that of the United Kingdom) and is the lead country of a wide number of illicit drug categories (see Figure 8). For instance, its leadership in the opioids category may be explained by the increase in heroin use in North America in the past decade (high prevalence compared to the worldwide mean). In contrast, Western and Central Europe have seen stable or declining long-term trends of heroin consumption since the late 1990s [26]. Finally, Chinese vendors, while five times fewer in number than Americans, lead the NPS category (27.7% of NPS listings). As further developed below, they specialise in the distribution of NPS (see also Figures 6 and 7), in which they play a strategic role. Another interesting observation is the non-existence of cocaine and heroin producing countries (e.g. South American countries or Middle East/South East/South West Asia). In general, these countries do not have access to the same technological infrastructure (e.g. the Internet, secure mail system) as westernised countries [7,18]. Furthermore, cryptomarkets may not represent a relevant distribution channel between producers and retailers in the case of cocaine and heroin.

3.6. A specific analysis of New Psychoactive Substances

Regarding the worldwide market, 363 vendors manage 3,936 listings classified in NPS (all three NPS related categories grouped). This represents almost 11% of the illicit drugs category (see Figure 8). As shown in Table 3, listings about illicit drugs shipped from China and Hong Kong represent about 4% of the total number of listings proposed on Evolution. However, the majority of their illicit drug listings concern new psychoactive substances (93% precisely, see Figure 6).

They cover almost 28% of all the NPS listings proposed on Evolution with only 22 vendors, which makes it the lead country, followed by the United States (26.5% - 115 vendors) and the United Kingdom (13.9% - 83 vendors) (see Figure 8). The combined analysis of masses and prices of the NPS proposed reveals geographical differences between the shipping countries (see Figure 8).

Most countries are characterised by a majority of listings offering small quantities of NPS (less than one gram or less than ten grams). However, vendors from China and Hong Kong offer larger quantities of NPS, between 10g and 100g, or even more. Thus, we may assume that vendors from China have the capacity to provide bulk quantities. Indeed, typical quantities for NPS consumption are usually very low, suggesting that quantities over 100g may already be considered as bulk. Price ranges also corroborate this finding. Listings offered for sale from China and Hong Kong show a median price lower than 10 USD per gram, while median prices are relatively higher for every other country. Of course, vendors usually propose

products at prices decreasing gradually when quantity increases. However, Chinese vendors are able to offer a lot of listings at high quantities at competitive prices in comparison to vendors from other countries. In conclusion, these results may indicate that Chinese vendors have easy access to these products or even may be involved in their production which would be in agreement with Smith & Garlich (2013) who stated that China played an active role in the domestic production of NPS [34]. Furthermore, this analysis corroborates the statements of vendors on their profiles concerning their ability to offer both small and very large quantities of NPS at lower prices

The importance of Chinese sellers in NPS production or distribution does not seem to be cryptomarket specific. Indeed, recent researches studying country specific differences in substance availability on the Agora cryptomarket found that China, despite a small number of sellers, was overrepresented in NPS. Using only the number of listings and sellers to draw their conclusions, the authors mentioned that China was probably involved in the production of NPS [8,9]. Another study, investigating wholesale activity on cryptomarkets, found that wholesale transactions were especially concentrated in China. According to the authors, this may be related to the role of China in the production of these substances [18]. Regarding NPS in general, or more specifically synthetic cannabinoids, China has always been suspected of being the place where these products are synthesised since the first appearance of “spice” products in 2004 [34–37]. It was also suggested that some substances are sent to Europe, or even North America, and then reconditioned for retail shipping [35]. On the clear web, China was also mentioned as the country of origin of websites offering MT-45, an opioid-like substance often referred to as a NPS [38]. However, this was not investigated further, for example by performing controlled purchases. Meyers and al. [39] also noted the accessibility of purchasing cathinones (a major class of NPS) on the clear web. They highlighted United States, together with Germany and the United Kingdom, as the three main countries where retailing websites were hosted. Concerning NPS shipments confiscated at borders, most cathinones seizures in 2009 in New Zealand originated from the United Kingdom or directly from China [40]. In Australia, in the period 2013 – 2014, NPS in kilogram quantities came primarily from China [41]. Thus, although based on only one cryptomarket, the results obtained through our study support various assumptions regarding the position of China within the NPS market.

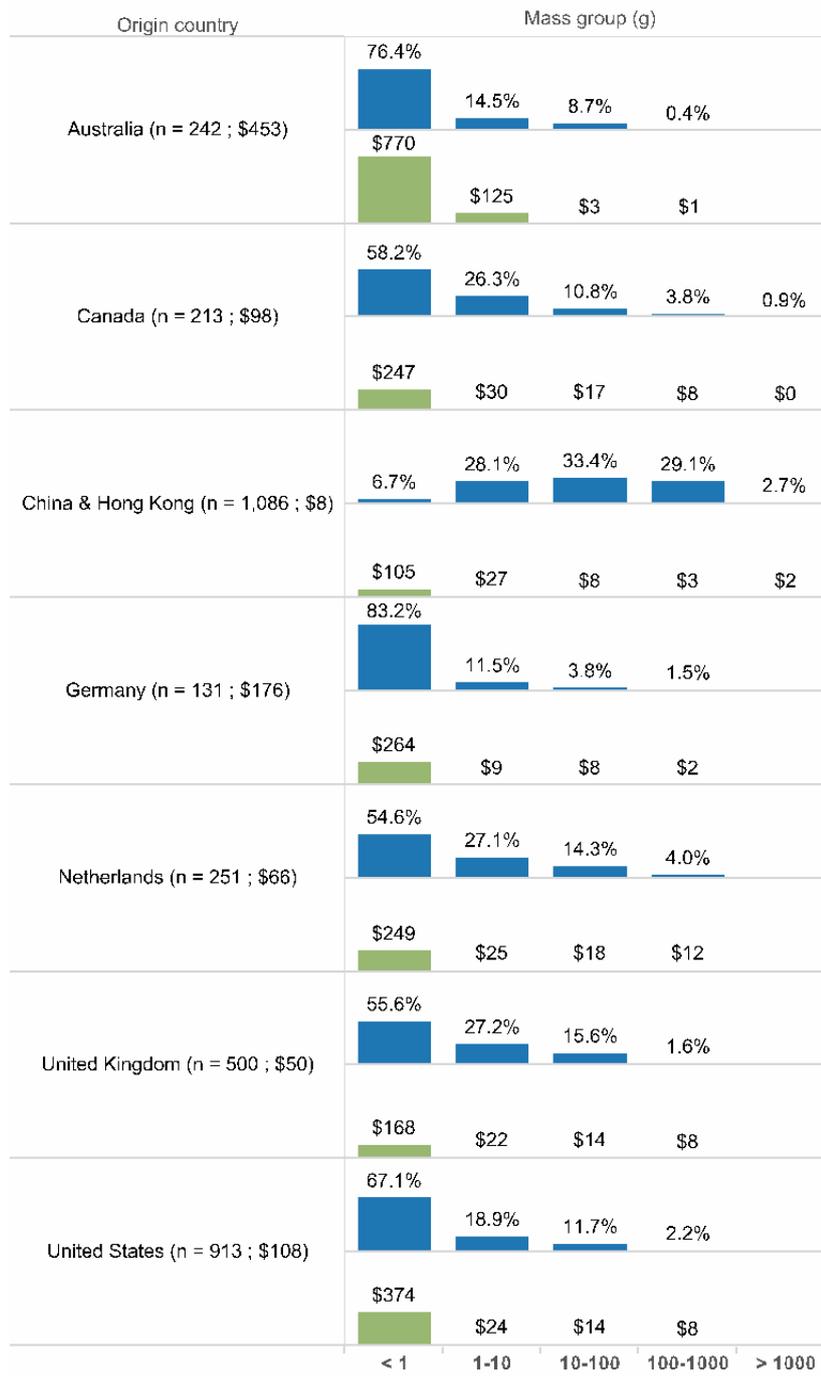


Figure 8. Proportions of listings (%) and median prices per gram (USD) according to the shipping country and the quantity proposed. The global median price per gram is mentioned into brackets along with the number of listings for each shipping country. Only the main shipping countries proposing NPS are represented.

4. General discussion and conclusion

Through the analysis of a dataset containing information on 4,171 vendors and 92,980 sale proposals, this study aimed first

at investigating the type and proportions of products offered for sale on Evolution, a popular darknet marketplace in 2014-2015. Then, this article studied the trafficking flows and geographical specificities in the trafficking of the different types of products, in particular illicit drugs. Finally, NPS were especially studied to show how digital data can inform on the role of specific countries in the distribution chain of products.

The results illustrate that the trafficking on Evolution is mainly devoted to the trade of illicit drugs. These substances represent 46% of all listings and 57% of vendors offer for sale at least one product classified as illicit drugs. Nevertheless, a wide range of other illicit products or services are offered as well. In particular, sale proposals related to various fraud issues (carding, ID theft, counterfeit goods, etc.) represent almost a third of the total number of listings and close to half of vendors propose products classified in this category. The spatial analysis we performed showed that English-speaking countries (especially the United States but also the United Kingdom and Australia) and Western European countries (the Netherlands, Germany) dominate the market, which is in line with past and more recent studies carried out on other cryptomarkets [8,10,11,16,20]. The study of trafficking flows reveals the domestic (e.g. Australia) and international (e.g. the Netherlands, Germany and China) nature of the trade of some countries. The spatial analysis also shows the specialisation of vendors and which countries are at the forefront of the distribution of specific types of products. For instance, vendors from the Netherlands and Canada specialise in trafficking prescription and illicit drugs, Indian vendors in prescription drugs, Chinese vendors specialise in luxury goods and NPS, while vendors from the United States dominate in a wide range of product categories. The combination of our results and other sources of information shows that geographical trends in the trafficking of specific type of illicit drugs tend to reflect the structure of the traditional market (e.g. prevalence data and role in the production of synthetic drugs). This may corroborate that sellers use cryptomarkets as a new distribution channel to sell all or part of their merchandise.

Nevertheless, the analysis of the number of vendors and sale proposals performed provides only information on the supply side of the market. To properly evaluate the role of countries on Evolution, as well as that of cryptomarkets in the distribution chain, it would be interesting to get an insight into the volume of sales of each country using the feedbacks left by past customers [2,11]. This would also better inform on the availability of the products offered for sale [18]. Unfortunately, the way data on Evolution were collected did not make possible such analysis. The data collected online, and used by researchers to evaluate different aspects of the trade on cryptomarkets - such as the vendor name, type of product, quantity, price, shipping country and destination(s) - are uncertain. Indeed, they depend on what the sellers state on their sale proposals and profiles. The only viable way to verify the accuracy of the online information is to purchase and evaluate a product [19,42]. However, an incoherence between the stated online information and that of the physical product shipped by post could have a negative impact on the reputation of the seller and consequently on his revenue [8]. A previous study showed that sellers seem to describe accurately their sale proposals, in particular their origin country and products offered for sale [14]. Indeed, customers can easily verify the country of origin of the purchased product, when they received it by mail since it is stated on mails shipped internationally [8]. Thus, even if the possibility exists that sellers do not provide accurate information, it seems unlikely that they do so in regards to the shipping country and the products offered for sale [8,18,25]. In addition, the stated origin country tends to be accurate, as evidenced by studies based on darknet orders [19], seizures of postal parcels at the borders [43] and coherence between online information and knowledge regarding the offline market [8,9].

In conclusion, the analysis of cryptomarkets should be integrated in a more global approach that aims to improve the knowledge of illicit market structures and trafficking, which is in line with a forensic intelligence approach. Developing strategies to monitor Internet activities on cryptomarkets and on dedicated forums are powerful means to observe and detect global and specific trends for different categories of products on the illicit market. This research demonstrates the importance of analysing all the data available on a cryptomarket to inform on the structure (e.g. type and frequencies of products, number of vendors, shipping countries and destinations, etc.) and dynamics (e.g. trafficking flows, emerging substances, specific trends, etc.) of the trade as well as on the role of certain countries in the trafficking and even specificities of their illicit market. In addition, our observations validate the hypothesis that the use of the shipping country statement truly inform on the origin of the products offered for sale. Performing a geographical analysis of trafficking on darknet marketplaces based on such statement can therefore be considered as appropriate. Since monitoring cryptomarkets may reveal country-specific trends, it could be seen as a new data source that would inform from a different perspective on the characteristics of the illicit market within the domestic context of particular countries. This would be particularly meaningful in the case of physical products such as (illicit) drugs. The knowledge obtained through this analysis could then be used at a tactical and operational level (e.g. to support specific operations) or at a strategic level (e.g. to obtain an understanding of the criminal activity) [44].

Appendix 1

On Evolution, product categories are typically self-selected by vendors from an existing list when creating a sale proposal, which is a source of uncertainty. Indeed, category names administrators had chosen did not inform on the type of products that was actually proposed. For instance, most of the illicit drugs or medicines categories were not defined according to the chemical structure of the products but instead to their effects. Moreover, it was not rare that vendors misclassified their listings. Furthermore, categories that were defined by administrators were not necessarily coherent considering the diversity in the type of products they contained. Lastly, it was possible to merge in the same category several listings spread into different categories since they concerned the same type of fraud issue or illicit activity (see Figs. A1 and A2). Thus, sale proposals were semi-automatically classified according to a list of keywords that we defined after a thorough analysis of all the listing titles. The new classification was performed according to the type of products offered for sale or to the nature of the illicit activity involved and included three main categories, in particular “Illicit drugs, drugs and paraphernalia”, “Various fraud issues” and “Other”. In a few words, listings originally classified in “Drugs” were reorganised in a number of categories in “Illicit drugs, drugs and paraphernalia” according to the general type of licit or illicit drug or equipment offered. In particular, apart from the usual illicit drugs (e.g. cannabis, cocaine, opioids, ecstasy, LSD), the products known as new psychoactive substances (NPS) were distributed between three subcategories. The four major classes – phenethylamines, cathinones, piperazines and tryptamines [46] – were listed as “NPS”. Their classification is based on the general chemical structure, shared by every substance of each category. Synthetic cannabinoids were classified separately since they may include herbal components and synthetic substances [47]. Substances not included in the two previous subcategories – due to a complex or anecdotal chemical characterization – were classified as “NPS—Other”. It includes for example benzofurans (e.g. 5-APB, 6- EAPB) or aminoindane analogues (e.g. MDAI) (see Fig. A2). Ketamine was classified in “Other”. In the “Various fraud issues” category, a significant proportion of the listings are part of the “Fraud Related” category. The latter mainly concerns listings on financial fraud and hacking services. In particular, most of the listings are related to carding. We also defined the “Goods, currencies and precious metals” category, which especially contains “Luxury goods” (mostly watches followed by jewellery and perfumes) and “Clothes and accessories” (mainly glasses, shirts, jackets and bags). These two categories contain products with a high probability of forgeries, as will be discussed below. The “Various fraud issues” also includes sale proposals about material related to identity theft such as false or stolen ID documents as well as data related to identity (“ID Related”). Moreover, a variety of electronic documents explaining how to perform some hacking or fraud related activities were listed as “Guides & Tutorials”. To a lesser extent, a number of sale proposals concern “Firearms & Weapons”, which is essentially constituted by the original “Weapons” category. Lastly, customers may request a specific listing from a vendor through private messaging [11]. A listing specifically designed for the customer will then be created, without necessarily stating the concerned product. They were classified in the “Custom listings” category if their title did not include any relevant keyword that may be used for classification in one aforementioned category (see Fig. A2).

Category 1	Category 2	Category 3	Category 1	Category 2	Category 3	
Drugs	-		Counterfeits	-		
	Benzos			Accessories		
	Cannabis	-		Apparel		
		Concentrates		Money		
		Edibles		Other		
		Hash		Custom Listings		
		Other		Digital Goods	-	
		Seeds			E	
	Synthetic		Other			
	Weed		Software			
	Disassociatives	-		Drug Paraphernalia		
		GHB		Electronics	-	
		Ketamine			SIM Cards	
		MXE		Erotica		
	Other		Fraud Related	-		
	Dissociatives	-			-	
		GBL			Accounts	Bank Logins
		GHB				Other
		Ketamine				Paypal
	MXE			CC & CVV		
	Other		Documents & Data			
	Ecstasy	-		Dumps		
		MDA		Guides & Tutorials	-	
MDMA			Drugs			
Other			Fraud			
Pills		Hacking				
Opioids	-		Other			
	Heroin		Security			
	Opium		Jewellery			
Other		Other				
Paraphernalia		Lab Supplies				
Prescription	-		Miscellaneous			
	Analgesics		Services	-		
	General Health			Hacking		
	Other			IDs & Passports		
	Relaxants			Other		
	Sildenafil Citrate		Paypal			
	Stimulants		Weapons	-		
Psychedelics	-			Ammunition		
	2C			Explosives		
	4			Guns		
	5			Melee		
	DMT			Other		
	LSD		Jewellery			
	Mescaline		Lab Supplies			
	Mushrooms		Miscellaneous			
	NB		Services	-		
	Other			Hacking		
Salvia		IDs & Passports				
Truffles		Other				
RCs		Paypal				
Steroids	-		Weapons	-		
	Stimulants			Ammunition		
Stimulants	-			Explosives		
	Cocaine			Guns		
	Meth			Melee		
	Other			Other		
	Speed		Jewellery			
Steroids		Lab Supplies				
Weight Loss		Miscellaneous				

Appendix 1 Figure A1. Categories of products as created by administrators of *Evolution*

ILLICIT DRUGS, DRUGS AND PARAPHERNALIA			VARIOUS FRAUD ISSUES			OTHER			
Category 1	Category 2	Category 3	Category 1	Category 2	Category 3	Category 1	Category 2	Category 3	
Illicit drugs	ATS	Amphetamine MDA Methamphetamine	Firearms & Weapons	Ammunition		Custom listings			
	Cannabis	Cannabis concentrates Edibles & seeds Hashish Marijuana		Explosives			Miscellaneous	Alcohol	Fraud Related
	Cocaine		Guns			Service	Other		
	Ecstasy & MDMA	Ecstasy MDMA Other	Melee			Other			
	LSD and derivatives		Other	Account (Bank, Paypal, Amazon) CC & CVV List Money laundering Shipping service Other					
	NPS	Cathinones Opioids Phenethylamines Piperazines Tryptamines		Carding					
	NPS - Other			Erotica					
	NPS - Synthetic cannabinoid			Hacking	Informatic Other				
	Opioids	Heroin Opium							
	Other	GHB and GBL Mushrooms Other							
Lab supplies & Paraphernalia	Bags		Goods, currencies and precious metals		Bag Belt Glasses Jacket Jeans Scarf Shirt Shoes Wallet Other				
	Chemicals and others			Currencies					
	Cutting agent			Electronic devices					
Electronics		Luxury goods		Jewellery Perfumes Watches					
Miscellaneous		Precious metals		Gold Silver					
Paraphernalia									
Press machine									
Other									
Performance and Image Enhancing Drugs				Guides & Tutorials	Illicit drugs				
					Fraud Related				
			ID Related						
Prescription drugs and medicines	Benzodiazepine		ID Related	Firearms & Weapons					
	Codeine and methadone			Other					
	Erectile dysfunction drugs			ID	ID pack Other				
	Miscellaneous			Identity theft	Account Fullz Other				
	Morphine derivatives			Various licenses and legitimization documents	Diplomas & Certificates License Report SSN Statements Other				

Appendix 1 Figure A2. Classification of sale proposals performed by the authors

Appendix 2

Information	Occurrence	Countries & regions mentioned
Shipping country	93	Afghanistan, Albania, Andorra, Argentina, Aruba, Australia, Austria, Azerbaijan, Bangladesh, Belgium, Bolivia, Bosnia and Herzegovina, Brazil, Bulgaria, Cambodia, Canada, Cayman Islands, Central African Republic, Chile, China, Christmas Island, Colombia, Czech Republic, Denmark, Dominican Republic, Egypt, El Salvador, Estonia, Ethiopia, Fiji, Finland, France, Gabon, Gambia, Georgia, Germany, Ghana, Greece, Guatemala, Guernsey, Hong Kong SAR China, Hungary, India, Ireland, Italy, Jamaica, Kenya, Latvia, Libya, Lithuania, Luxembourg, Malaysia, Mexico, Netherlands, Netherlands Antilles, New Zealand, North Korea, Norway, Pakistan, Peru, Philippines, Poland, Portugal, Romania, Russia, Saint Kitts and Nevis, Sao Tome and Principe, Saudi Arabia, Serbia, Singapore, Slovakia, Slovenia, South Africa, Spain, Sri Lanka, Svalbard and Jan Mayen, Swaziland, Sweden, Switzerland, Taiwan, Tanzania, Thailand, Timor-Leste, Togo, Uganda, Ukraine, United Kingdom, United States, Uruguay, Western Sahara, Worldwide, Yemen, Zimbabwe.
Shipping destination	164	Afghanistan, Albania, Algeria, American Samoa, Andorra, Angola, Anguilla, Antarctica, Antigua and Barbuda, Argentina, Armenia, Aruba, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belgium, Belize, Benin, Bermuda, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Bouvet Island, Brazil, Brunei, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Canton and Enderbury Islands, Cape Verde, Cayman Islands, Central African Republic, Chad, Chile, China, Christmas Island, Cocos [Keeling] Islands, Colombia, Comoros, Congo—Brazzaville, Congo—Kinshasa, Cook Islands, Costa Rica, Cote d'Ivoire, Croatia, Cuba, Cyprus, Czech Republic, Denmark, Djibouti, Dominica, Dominican Republic, Dronning Maud Land, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Estonia, Ethiopia, Falkland Islands, Faroe Islands, Fiji, Finland, France, French Guiana, French Polynesia, Gabon, Gambia, Georgia, Germany, Ghana, Gibraltar, Greece, Greenland, Grenada, Guadeloupe, Guam, Guatemala, Guernsey, Hong Kong SAR China, Hungary, Iceland, India, Indonesia, Ireland, Isle of Man, Israel, Italy, Japan, Latvia, Lebanon, Lesotho, Liechtenstein, Lithuania, Luxembourg, Macau SAR China, Macedonia, Madagascar, Malaysia, Malta, Mauritius, Metropolitan France, Mexico, Moldova, Monaco, Montenegro, Morocco, Netherlands, Netherlands Antilles, New Zealand, North Korea, Norway, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Puerto Rico, Romania, Russia, Saint Lucia, San Marino, Sao Tome and Principe, Senegal, Serbia, Serbia and Montenegro, Singapore, Slovakia, Slovenia, Somalia, South Africa, South Korea, Spain, Sri Lanka, Svalbard and Jan Mayen, Swaziland, Sweden, Switzerland, Taiwan, Thailand, Trinidad and Tobago, Tunisia, Turkey, Tuvalu, Ukraine, United Kingdom, United States, Uruguay, Vatican City, Venezuela, Vietnam, Worldwide, Zimbabwe.

Appendix 2 Table B1 Shipping countries and destinations mentioned by vendors

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