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Abstract | This study provides a snapshot of the availability of weapons across eight omnibus or 'High Street' and 12 specialist darknet or illicit cryptomarkets between July and December 2019.

Overall, 2,124 weapons were identified, of which 11 percent were found on niche markets. On all markets, weapons for sale included 1,497 handguns, 218 rifles, 41 submachine guns and 34 shotguns. Also available were ammunition (*n*=79), explosives (*n*=37) and accessories such as silencers (*n*=24).

Omnibus markets also sold other weapons (*n*=70) such as tasers, pepper spray and knives, and digital products (*n*=112), mostly DIY weapon manuals, as well as chemical, biological, nuclear and radiological weapons (*n*=12).

The data allowed for estimates of the cost of weapons and some description of the 215 vendors identified, 18 (8.4%) of whom were active across more than one market.

Illicit firearms and other weapons on darknet markets

Roderic Broadhurst, Jack Foye, Chuxuan Jiang and Matthew Ball

Introduction

The illicit trade in illegal firearms and weapons is a global issue that threatens the rule of law, police operations and the safety of civilian populations. The threat is magnified in conflict zones where a state's monopoly over the means of violence is contested. The trafficking of illicit firearms, ammunition and explosives—or small and light weapons (SALW)—is a pivotal criminal activity that enables organised crime, fuels violence and terrorism, and contributes to civil disorder (European Monitoring Centre for Drugs and Drug Addiction & Europol 2019; United Nations (UN) 2017). Firearms and other weapons bought on the darknet have been used to commit acts of terrorism and targeted violence (Paoli et al. 2017: 3).

Trafficking in firearms through diversion from licit to illicit markets poses a threat to public safety. In Australia, where legal firearm ownership is strictly regulated, illicit firearms are in demand among organised crime groups and criminals. Illicit firearms are a tool to intimidate and commit violent acts, and enable engagement in organised crime and other serious crimes (Australian Criminal Intelligence Commission (ACIC) 2016: 6).

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Australia is party to the Firearms Protocol of the UN Convention Against Transnational Organised Crime (2001) and the UN Arms Trade Treaty (2014), which provide a cross-national legal framework for the suppression of the illicit manufacture and trafficking of SALW. The Arms Trade Treaty regulates the international trade in firearms including their diversion from the licit trade in SALW (UN Office on Drugs and Crime (UNODC) 2016: 3).

Exemplifying the transnational nature of the darknet arms trade, a joint operation in 2018 involving the US Bureau of Alcohol, Tobacco, Firearms and Explosives, the US Postal Inspection Service, the Australian Customs and Border Protection Service and the Australian Federal Police recovered in Australia illegal firearms purchased with Bitcoin from the darknet Black Market Reloaded. Four men residing in the US state of Georgia pleaded guilty to smuggling firearms by post from the United States to Australia hidden inside electronic equipment. The illicit firearms were obtained through this US-based syndicate (alias 'CherryFlavour') that operated an international firearms trafficking enterprise that dispatched over 70 firearms at marked-up prices to other countries including Austria, Belgium, Canada, Denmark, France, Germany, Ireland, Kazakhstan, the Netherlands, Russia, Sweden, the United Kingdom and Zambia. The popular Glock pistol, usually sold for US$500, was available through CherryFlavour for US$3,400 (US Department of Justice 2018). In another case in 2018, New South Wales police arrested a 28-year-old man (alias 'silly112') for allegedly attempting to purchase three firearms (a Glock, AK-47 and Uzi) and ammunition from the darknet by transferring funds (A$10,070) from his cryptocurrency account (Partridge 2018).

In 2016, the ACIC estimated there were approximately 2,850,000 civilian-owned firearms in Australia, with another 300,000 held in military and law enforcement armouries (ACIC 2016; Karp 2018). Legal, 'grey' and illicit markets operate in Australia. The legal market consists of all firearms that have been registered by, and are owned by, an individual with a relevant licence. The 'grey market' refers to firearms that were legally owned but not surrendered or registered following the initial 1996–98 National Firearms Agreement (NFA) gun buyback program (Bricknell 2012). This NFA was Australia's response to the 1996 mass murder of 35 people at Port Arthur by a lone offender armed with military style semi-automatic rifles (eg Colt AR-15). The latest Council of Australian Governments (2017) NFA continues to strictly regulate the import and ownership of firearms (see Customs (Prohibited Imports) Regulations 1956 (Cth), sch 6, part 2). Grey market firearms are not kept for criminal purposes, but may be an avenue for diversion into the illicit market (Bricknell 2012: 23). The ACIC estimates that about 260,000 unlicensed firearms (including 10,000 handguns) may be in circulation (ACIC 2016: 7).

The illicit market consists of firearms that are illegally manufactured, imported or diverted from either the licit or grey markets or stolen from individuals or firearm dealers (ACIC 2016; Bricknell 2012: 23). Theft of firearms had increased 35 percent since 2008–09, with most thefts targeting regional residential premises (Bricknell 2020). As this paper focuses on illicit firearms, hereafter the use of the term 'weapon', 'firearm' or 'SALW' refers to illegal firearms and weapons unless otherwise specified.

The global market in SALW, including parts, accessories and ammunition, was estimated to be worth annually US$1.7b to US$3.5b in 2014, or approximately 10 to 20 percent of the legal arms trade (Grzybowski, Marsh & Schroeder 2012: 241; May 2017: 14; UNODC 2010: 129). A significant amount of SALW trafficking is small-scale transfers and predominantly (53%) handguns (UNODC 2020: 19, 25). Based on SALW seizures in 2013 reported by the UNODC (2015), about 14 percent of cases were detected through mail inspections, but this comprised only 7.4 percent of the estimated 1.39 million SALW items smuggled across borders by sea, rail or air (UNODC 2015: 7, 55, cited in May 2017: 17). Firearm trafficking was also undertaken on the open internet (eg often for repackaging from US sources and resold abroad) and has also become available on darknet markets (May 2017: 18; Schroeder 2016: 4).

Darknet markets and illicit weapons

The use of cryptocurrencies (eg Bitcoin, Monero) and anonymised online markets for the sale of illicit firearms is a relatively new and small component of the illicit trade in SALW. Darknet markets found on encrypted internet platforms such as Tor sell contraband, such as drugs and malware, and are another transnational vector for firearms trafficking. A distinct single-vendor or niche service has evolved along with routine listings of illicit firearms and weapons on larger omnibus or 'High Street' darknet markets. This is despite many of these larger markets discouraging the sale of weapons and other high-risk contraband such as child abuse images. Three previous studies, all drawing on data collected in 2016, have reported separately the prevalence and types of illicit weapons found on either niche or omnibus darknets. These show that the darknet illicit trade in SALW is a small but significant fraction of all illicit activity on darknet markets.

Paoli et al. (2017) found 811 weapons, including 339 firearms (or 42% of all weapons), among all 167,693 listings (0.5% of all products) found on 12 Tor omnibus markets surveyed in September 2016. These markets were AlphaBay, Dream Market, Oasis1, Valhalla, Hansa, Python, The Detox Market, Traderoute, Minerva, Acropolis, Tochka and Dark-net-heroes-league. Tochka was still active in mid-2019 and is included in the present study. Other weapons such as knives and batons (*n*=178, 21.9%), digital products such as DIY weapons (*n*=222, 27.4%), ammunition (*n*=54, 6.7%), explosives (*n*=6, 0.74%) and parts or accessories (*n*=12, 1.5%) were also available (Paoli et al. 2017: 29). Of the firearms, 284 (84%) were handguns (Paoli et al. 2017: 30). The revenue generated from the sale of weapons was an estimated US$80,000 per month (Paoli et al. 2017: 113).

Rhumorbarbe et al. (2018) collected data in February 2016 from nine Tor darknet omnibus markets (Aflao, AlphaBay, Dr D's, Dream Market, French Darknet Market, The Real Deal, Oasis, Outlaw Market, and Valhalla). None of these was active at the time of our data collection in mid-2019. These authors identified 386 weapons (total listings not provided). Of these, 98 (25.4%) were firearms, 109 (28.2%) were 'non-lethal' weapons (eg tasers and pepper sprays) and 64 (16.6%) were 'melee' weapons (eg knives, brass knuckles). Other items listed included 34 (8.8%) digital products, 32 (8.3%) listings of ammunition, 21 (5.4%) explosives that included flares and firecrackers, 21 (5.7%) 'customised' items and six (1.6%) 'other' or miscellaneous listings not detailed. They concluded that online firearms trafficking was marginal, less established than darknet illicit drug markets and inherently riskier because of the challenges in stealth delivery using mail services (Rhumorbarbe et al. 2018: 19).

Copeland, Wallin and Holt (2019) surveyed six single-vendor (niche) firearms markets on Tor (Luckp-47, Black Market, Darkseid, Euro Guns, UK Guns & Ammo and Manufrance) between February and May 2016. All these markets are included in the present study except Manufrance, which ceased operations before our data collection commenced. These authors identified 105 firearms, of which 77 (74%) were handguns—mostly semi-automatics. Firearms manufactured by well-known companies such as Colt, Smith & Wesson, Glock and Beretta were available, and in their sample these firearms had mainly NATO or Western ammunition calibre specifications. Most firearms (*n*=71, 74%) were sold by Luckp-47, which claimed to be a paramilitary organisation protecting the Ukraine city of Luhanska. Firearms on these niche markets mirror those found in the licit SALW trade; this suggests most products originate from licit markets and are diverted into illicit markets (Copeland, Wallin & Holt 2019: 10).

Tor darknet markets are not the only means of clandestine online weapons trafficking. Jenzen-Jones and McCollum (2017) observed the online trade of small and light arms in Libya facilitated by the use of social media, especially Facebook, after the demise of the Qaddafi regime. They described 1,346 transactions that advertised the sale of illicit weapons between November 2014 and November 2015 (Jenzen-Jones & McCollum 2017: 14, 26). Most (72%) transactions were classified as SALW (including a disproportionate number of handguns); small and medium calibre ammunition (16.3%); and heavier weapons, military equipment and ordnance (11.7%; Jenzen-Jones & McCollum 2017: 33). Blank firing handguns capable of being converted into lethal firearms by buyers or sellers were also identified (Jenzen-Jones & McCollum 2017: 15).

This study adds to the limited literature on the darknet illicit weapons trade and provides a snapshot of the available firearms and weapons, their prices, vendors and markets. In this study we identify illicit firearms and weapons advertised or listed across 12 niche and eight omnibus markets. We address the question: how many and what types of firearms, explosives, ammunition or other weapons (eg knives, tasers, poisons) were available between July and December 2019?

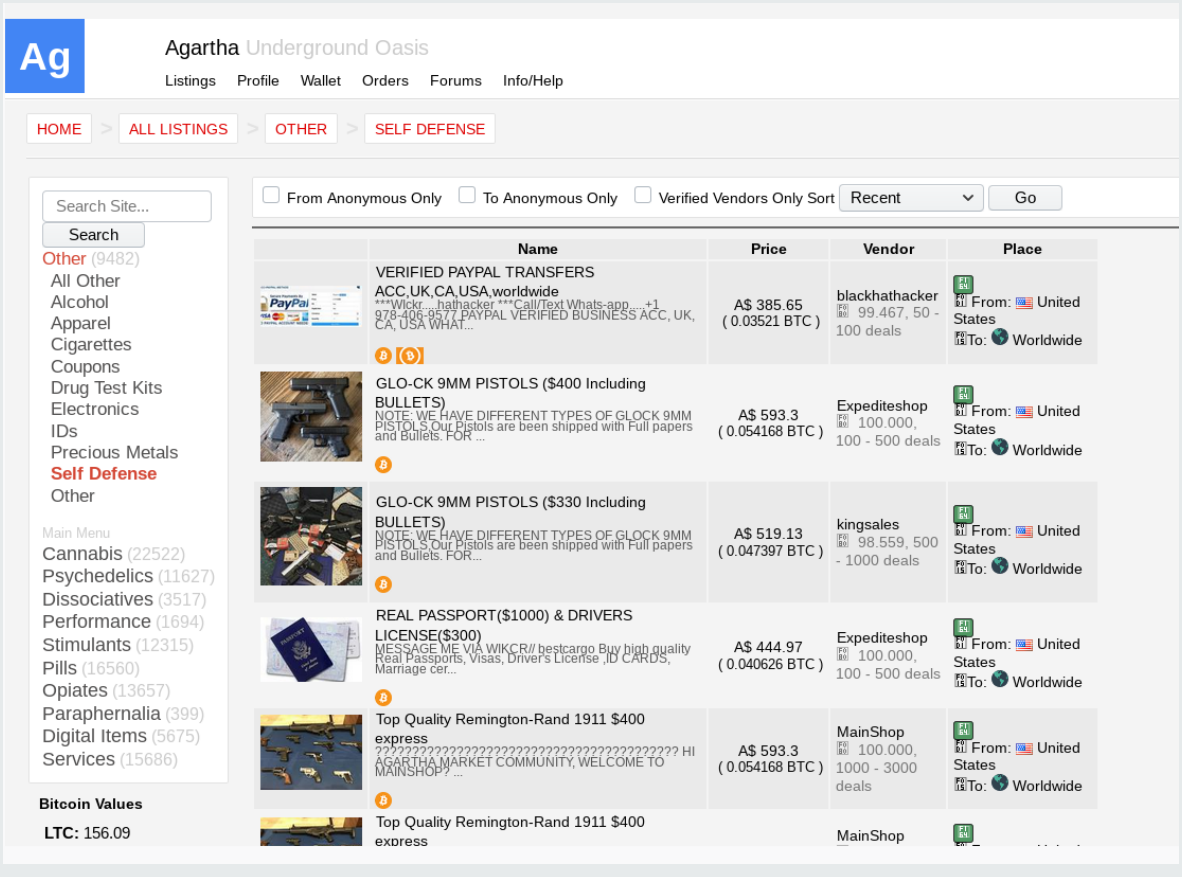
Method

This study draws on data collected using a web crawler designed to function on the Tor platform. This process creates a static copy of the website listings that allows data extraction from HTML pages for subsequent classification of weapon categories, estimates of prices and quantities, and analysis of vendor activity. This process is crucial in the case of volatile darknet markets. We report only the unique listings found for firearms, ammunition, explosives and other weapons, including digital products related to weapons. Listings or advertisements provide the available data but may not reflect actual sales. Figure 1 shows listings on Agartha, an omnibus market, and Figure 2 shows Luckp-47, a niche market. These screenshots illustrate the content captured from the darknet markets crawled. Further details of the methods used can be found in Ball et al. (2019).

Multiple listings of more than one weapon type by a vendor were frequent and required visual inspection of the listing and image to both verify and sub-classify the firearm and weapon type. Some listings were also generic: for example, 'cheap handguns/pistols', 'rifles assault good condition' or 'special offer (NIB – new in box) Austrian pistol'. These generic listings also required inspection. We adopted a conservative approach and likely duplicates were removed (eg the same product offered by the vendor but in another language or with minor variation in format or word order). Due to the diversity of weapon descriptions and categories all possible listings were manually reviewed. This also provided further information, if available, about chamber calibre and manufacturer.

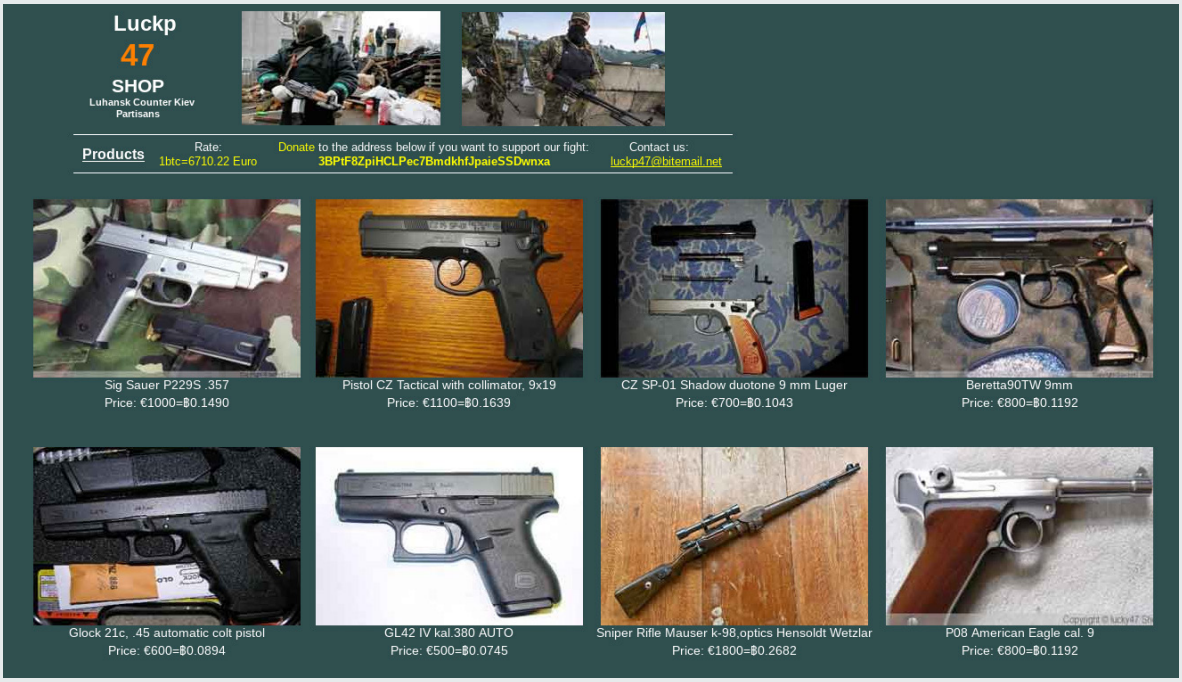
We report the type of firearm and weapon listed on each market as claimed by vendors. Legal and ethically approved purchases have not been undertaken to verify their claims. Darknet markets are vulnerable to scams and it is likely that some vendors and markets are not genuine. Dark Shades, for example, may have been a scam or honeypot given the static list of its products and prices. Omnibus and niche markets usually offer escrow services (ie funds are held by the darknet market administrators on behalf of both buyer and vendor until the transaction is completed) that reinforce trust in transactions.

Figure 1: Omnibus market screenshot—illicit firearm listings on Agartha



Source: ANU Cybercrime Observatory, 2 December 2019 [computer file]

Figure 2: Niche market screenshot—illicit firearm listings on Luckp-47



Source: ANU Cybercrime Observatory, 2 December 2019 [computer file]

Data were collected between 8 July and 16 December 2019. Data were captured daily from eight omnibus markets (Agartha, Apollon, Berlusconi, Dark Shades, Empire, Nightmare, Samsara and Tochka) and were combined with data collected weekly from 12 niche markets that specialise in SALW. Niche markets, although often operated as syndicates, appear as a single vendor. The niche markets for which we collected data were The Armory, Black Market Guns, Black Market, Darkseid, Euro Guns, Luckp-47, UK Guns and Ammo, Firearms72, DeepWeb Guns Store, Guns & Ganja Private Club, Danaucolt Ghost Gun and Gun Shop 2019. Overall, data were collected for 22 weeks from 20 darknet markets.

Omnibus markets attempt to mitigate risk by not listing 'forbidden products and services' (eg assassinations, weapons, poisons, fentanyl, child abuse material and depictions of people being hurt or murdered). However, we found a mixture of approaches to this. Tochka did not exclude SALW. Agartha and Berlusconi, despite apparent bans, took no action to remove firearm listings, while Empire removed them.

During the collection period, five omnibus markets ceased operations due to exit scams (ie market operators close the market and steal buyers' and vendors' funds held in escrow), voluntary closures or law enforcement seizures: Nightmare on 26 July, Berlusconi and Dark Shades on 28 September, Samsara on 8 November and Tochka on 28 November. Nightmare and Tochka executed an exit scam. Samsara's was a 'soft exit', because it continued escrow services while undergoing an orderly closure. The Italian *Guardia di Finanza* seized Berlusconi and arrested its three Italian administrators. Thus, from our original pool, only Apollon, Empire and Agartha remained active at the close of data collection. This volatility affected the availability of illicit weapons and reduced the number of active vendors over the study period.

Data analysis first required a list of search terms (or wordlists qualitatively identified through observations of the markets) corresponding with SALW firearms, ammunition, explosives and accessories. Other weapons typically not classified as SALW were also included, such as digital products; chemical, biological, radiological or nuclear (CBRN) weapons; knives; and 'non-lethal' weapons. These were grouped into 10 categories for analysis as follows:

- rifles (eg assault, semi-automatic and single shot);
- handguns (eg pistols, revolvers and derringers);
- shotguns (eg 12 gauge);
- submachine guns (eg Uzi, MP5);
- explosives (eg grenades, rocket-propelled grenades (RPGs), RDX, C-4, dynamite);
- accessories (eg scopes, silencers, night vision devices, combat vests);
- ammunition of various calibres;
- digital products (eg DIY manufacturing guides, the *Anarchist cookbook*, 3D firearm files in CAD file formats);
- chemical, biological, radiological or nuclear weapons; and
- miscellaneous (eg knives, brass knuckles, tasers, pepper spray, replicas and airsoft guns).

The alignment of these categories with the Australian NFA classifications and Customs (Prohibited Imports) Regulations is mapped in the *Appendix* (Table A1). There was often limited information on which to accurately categorise firearms available on the darknet and classify them according to the Customs and NFA categories.

Composing a comprehensive but precise wordlist for searching weapon categories across the omnibus markets proved problematic. Most products sold on omnibus markets are illegal drugs and many are sold under common street names that also adopt the names of firearms. Cannabis, for example, is often sold under the name 'AK-47', 'Brass Knuckles' is a brand of cannabis oil, 'Glock' is a brand of cannabis seeds and 'Grenade XTC' is a name for ecstasy pills. These alternative meanings could not always be excluded and visual inspection of all probable listings was required to confirm that a firearm or weapon, rather than another product, was included. Intentionally misspelled terms were also encountered. These may have been intended to foil removal by markets that discouraged the sale of illicit firearms and weapons.

We first undertook a descriptive analysis of the availability and cost of illicit weapons, with a focus on the different types of firearms and other weapons identified and the market (omnibus or niche) involved. Analysis of advertised prices for all weapon categories found outliers for the price of firearms, and price distributions were heavily skewed. Consequently, we report the median prices as well as the mean values for each category and performed Mann–Whitney tests to statistically assess the difference between price distributions across omnibus and niche markets.

Results

Overall, 2,124 illicit weapons were identified from the 1,099,257 unique listings found on all markets—just under a fifth of one percent of all listings (0.193%). Of these, 235 (11.1%) were listed on niche markets and 1,889 (88.9%) on omnibus markets. The most common categories were handguns (70.5%), followed by rifles (10.3%), ammunition (3.7%), submachine guns (1.9%), explosives (1.7%), shotguns (1.6%) and accessories (1.1%). Digital products (5.3%), CBRN (0.64%) and miscellaneous weapons (3.3%) were only listed on omnibus markets. Table 1 shows the significant differences in the availability of different types of firearms and other weapons for niche and omnibus markets. Figure 3 shows these differences for omnibus markets and Figure 4 for niche markets.

The majority of handguns (*n*=1,316, 88%) were classed as semi-automatic pistols, 138 were revolvers (of which six were derringers) and one was a rare bolt-action handgun. Forty-two handguns were unable to be classified further due to insufficient data.

Most revolvers were manufactured in the United States, such as Colt (*n*=18), Smith & Wesson (*n*=62) and Ruger (*n*=33). With the Brazilian-manufactured Taurus (*n*=9), these together accounted for almost all revolvers.

Among semi-automatic pistols the most common chamber was for the 9mm calibre round (*n*=809, 61.5%) although many were available in other calibres. Semi-automatic polymer-frame Glocks (*n*=751, 57.1%) were the most common handgun. The Austrian maker of Glocks (Glock GmbH) also manufactures in other countries, including the United States and Brazil. 'Select-fire' (automatic) conversions are possible for some models and we identified one select-fire automatic Glock 18.

Other semi-automatics manufacturers identified included the Italian Beretta (*n*=102), the formerly Swiss German now US made SIG Sauer (*n*=75); and US brands Colt (*n*=52), Springfield Inc (*n*=34), Ruger (*n*=32), Smith & Wesson (*n*=22), Kimber America (*n*=18), Remington (*n*=15) and Magnum Research (*n*=12). Other manufacturers included Czech Armory-CZ Firearms (*n*=31); Walther (*n*=26) and Heckler & Koch (*n*=19) from Germany; Brazilian Taurus (*n*=14); and the Russian company Kalashnikov Concern (*n*=12).

Table 1: Weapon availability on omnibus and niche markets

Weapon category	Omnibus markets % (*n*)	Niche markets % (*n*)	All % (*n*)
Handguns	73.16 (1,382)	48.94 (115)	70.48 (1,497)
Rifles	8.05 (152)	28.09 (66)	10.26 (218)
Digital products	5.93 (112)	0 (0)	5.27 (112)
Ammunition	3.07 (58)	8.94 (21)	3.72 (79)
Miscellaneous	3.71 (70)	0 (0)	3.30 (70)
Submachine guns	1.54 (29)	5.11 (12)	1.93 (41)
Explosives	1.59 (30)	2.98 (7)	1.74 (37)
Shotguns	1.43 (27)	2.98 (7)	1.60 (34)
Accessories	0.90 (7)	2.98 (7)	1.13 (14)
CBRN	0.64 (12)	0 (0)	0.56 (12)
Total[a]	100 (1,889)	100 (235)	100 (2,124)
Total[b]	**88.94 (1,889)**	**11.06 (235)**	**100 (2,124)**

a: Percentages are based on column totals

b: Percentages are based on row totals

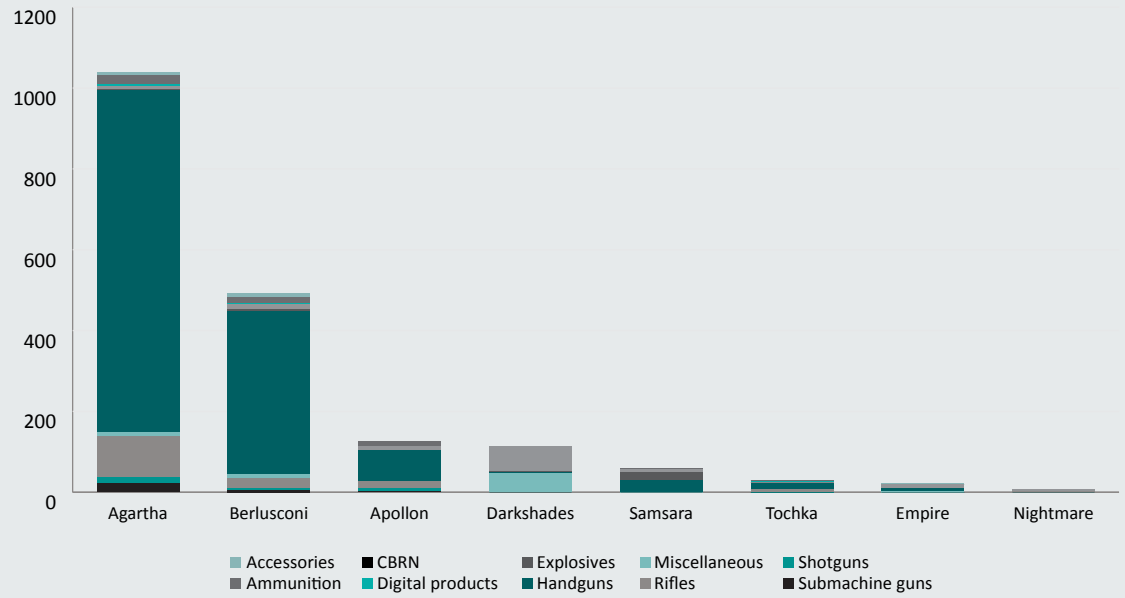
Note: A Pearson's chi-square test assessed homogeneity and showed a significant difference between omnibus and niche markets' listings (χ^2=169.89, *p*-value=0.0005). CBRN=chemical, biological, radiological or nuclear weapons

Across all markets, 218 rifles were identified. The Kalashnikov (also known as the AK-47) was the most common of the select-fire rifles (*n*=49, 23%) followed by the Colt AR-15 (*n*=12, 5.5%). However, 10 (4.6%) select-fire rifle listings provided no additional details such as manufacturer or calibre. Bolt-action (*n*=28, 12.8%) and lever/break action (*n*=11, 5%) rifles were also found and two rifles lacked sufficient information to classify further. About a half of all rifles were semi-automatic (*n*=108, 49.6%) and were sourced from a variety of US, European and other manufacturers. Many semi-automatic rifles had the potential for conversion to select-fire with the aid of online resources and conversion kits (Europol 2017; Florquin & King 2018: 16).

Explosives were mostly grenades, including incendiary, gas or smoke versions (*n*=25). Three RPGs, including two specifying 37mm high explosive grenades (an associated image showed a Soviet era RPG-7 minus optic and heat shield), and two listings each of dynamite, RDX and C-4 (*n*=6) were available.

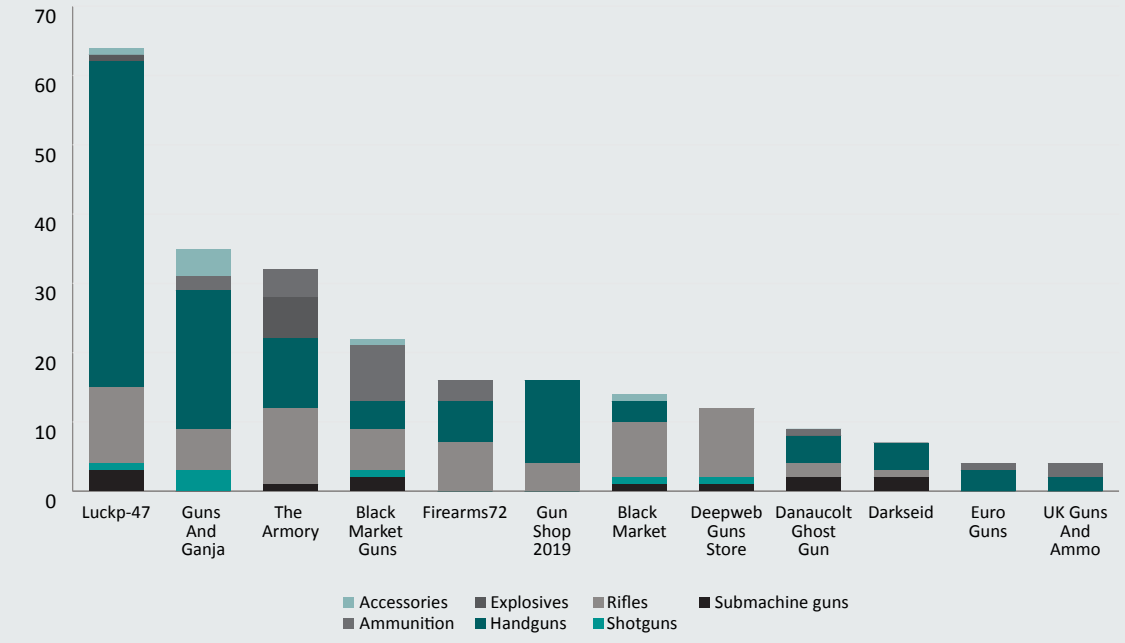
Accessories for firearms comprised scopes or optical aids (*n*=10, including two night vision devices), silencers (*n*=6), magazines (*n*=4), wearables (*n*=2), rifle under-fold stocks (*n*=3) and a single grenade launcher (without ammunition).

Figure 3: Firearms and other weapons listed on omnibus markets (*n*)



Note: CBRN=chemical, biological, radiological or nuclear weapons

Figure 4: Firearms and other weapons listed on niche markets (*n*)



The miscellaneous category included airsoft firearms (*n*=14); these are potentially convertible to lethal versions and are classified as SALWs (Florquin & King 2018: 12). In addition, knives (*n*=20), tasers and stun guns (*n*=18), pepper spray (*n*=4), brass knuckles (*n*=3) and batons (*n*=10) were found on omnibus but not niche markets.

Digital products mostly comprised general DIY manuals (*n*=70) or 3D weapon files (*n*=10) as well as three manuals for making replica RPGs. A single 3D model Berretta handgun was also identified and classified as SALW; this is a prohibited 'replica' in Australia. In addition, 29 listings offered William Powell's popular illustrated *Anarchist cookbook* (first published in 1971) for homemade weapons, electronics, drugs and explosives.

Niche markets offered rifles, ammunition and submachine guns as well as handguns, albeit with a limited range of models. Two niche markets offered explosives grenades (*n*=7) and four offered accessories such as scopes (*n*=7). As noted earlier, niche markets did not offer digital products, CBRN or other (miscellaneous) weapons. Typically consistent in price and weapon offerings, no niche market ceased trading during data collection. Three niche markets—Luckp-47 (*n*=64), Guns & Ganja (*n*=35) and The Armory (*n*=32)—accounted for over half (55.7%) of all niche listings, while each of the other niche markets offered at most a handful of products (see Figure 4).

Of the omnibus markets, Agartha listed 1,040 weapons (846 handguns) and, until its demise, Berlusconi listed 492 weapons (404 handguns). Handguns accounted for over 80 percent of the firearms available from either of these markets. Both of these markets sold all categories of weapons and accounted for most listings (81.1%) on omnibus markets (see Figure 3). Berlusconi's seizure in late September 2019 resulted in an increase in weapons available on Agartha (from 478 by 8 October to 1,040 by 16 December 2019). Only 180 weapons were present at the end of the data collection and these were all on Agartha. No increase in weapons availability was observed on Tochka prior to its exit in November or on Apollon, although it remained active.

Prices of illicit firearms and other weapons

The prices of weapons varied considerably depending on the category. Bitcoin was typically the preferred payment method. We investigated differences in the listing prices advertised on omnibus and niche markets. Table 2 summarises the average and median Australian dollar values for the main firearm and other weapon categories. The median price of handguns was A$964; however, within this group, the median price of revolvers (*n*=132; A$808) and derringers (*n*=6; A$792) was less than the median price of semi-automatic pistols (*n*=1,316; A$1,002).

Rifles on average sold for A$1,817 but prices were much higher for specialist bolt-action rifles (*n*=28) or select-fire automatic rifles, notably those that included optical accessories. Select-fire (*n*= 69) and semi-automatic rifles (*n*=108) were available for similar prices, although military variants of select-fire models were less expensive than 'civilian' semi-automatics (ie median A$1,215 versus A$1,389).

This median price was generally comparable to the range of prices reported for AK-47s from several sources between 2011 and 2014; however, a price of US$2,800–US$3,600 has previously been reported on the notorious first version of the niche darknet The Armory (O'Neill 2014, also cited in May 2017: 103). Niche markets such as Luckp-47 also offered AK-47s at a 'discount' price of €700 (about A$1,145) and implied that they were decommissioned rifles sourced from military armouries in Eastern Europe.

Table 2: Firearms, explosives, CBRN and digital products by price (all markets in A$)					
Weapon	**Count**	**Mean**	**Median**	**Maximum**	**Minimum**
Submachine guns	41	$2,941.40	$1,531.30	$10,840.80	$543.40
Rifles	218	$1,817.10	$1,288.30	$10,966.40	$199.30
Handguns	1,497	$1,233.70	$964.70	$13,087.50	$73.60
Shotguns	34	$1,525.90	$943.20	$11,008.10	$294.40
CBRN	12	$1,024.70	$810.10	$2,572.50	$14.70
Explosives	37	$473.90	$361.40	$5,609.00	$31.20
Digital products	112	$10.00	$3.10	$560.90	$1.40

Note: CBRN=chemical, biological, radiological or nuclear weapons

The average price of submachine guns was A$2,941. Submachine guns were significantly more expensive than other firearms based on the Mann–Whitney test. The average price of shotguns was A$1,525, with tactical versions and handmade hunting versions fetching higher prices.

The most expensive handgun was the high-quality Swiss made B&T (formerly Brügger & Thomet AG) 45 calibre chambered semi-automatic pistol or submachine gun with optical accessories and brace (folding stock). This was valued on the legal market at A$3,600–A$3,900 but was available for A$13,088 on Berlusconi. This firearm typified the premium prices sought for the select-fire machine pistol format and hybrid short barrel select-fire or semi-automatic rifle.

The most expensive rifle was the Allen Precision (APS X.H.S) hunting rifle chambered for a 338 Lapua Magnum cartridge and fitted with a high-value scope and other features; this rifle would cost A$6,270–A$7,320 on the legal market but was available for A$10,996 on The Armory. Finally, a handcrafted 20 gauge 'game' or hunting shotgun made in Basque Spain by 'Armas Garbi' was one of the few firearms where the A$11,008 price tag on Agartha was below the usual open market price for these weapons (A$14,933–A$22,250).

A handful of gold-plated firearms or parts were available and this feature elevated prices accordingly. For example, a 24-carat AK-47 under-fold rifle was valued at A$2,040 and a 'gold' AK-47 was listed at A$2,232; similar items included a gold-plated Colt (1911 model) semi-automatic pistol (A$5,066), a Magnum Research Model Desert Eagle chambered for a 44 Magnum cartridge (A$3,780), an STI 1911-style semi-automatic pistol (A$3,543) and a 'gold' Beretta 682 shotgun (A$4,828).

Prices of explosives varied according to the type of explosive: the median price of grenades (*n*=16) was cheaper (A$333) than C-4 and dynamite (*n*=4; A$459), while an RPG sold for A$5,609 and a grenade launcher for A$1,930. CBRN prices also varied, with the median value of radiological products such as polonium (*n*=4; A$728) cheaper than nuclear materials such as uranium (*n*=2; A$1,169) or chemicals such as potassium cyanide or tetrodotoxin (*n*=6; A$1,110).

Ammunition (*n*=79) was sometimes sold as a box of 50 rounds, at a median price of A$169 per box. Less frequently available were larger quantities of ammunition: amounts of over 500 rounds were more expensive than smaller quantities of less than 100 rounds. Prices varied according to calibre, and ammunition was often sold with a firearm.

Among firearm accessories the average cost of scopes was A$1,658 and silencers A$864. Night vision devices were valued much higher than other accessories, with a military grade monocular night scope available for A$4,547 and retailing for a similar price on the open market at A$4,900.

For the miscellaneous category (*n*=70; median=A$67) prices also varied, but non-lethal weapons, such as some taser models, were available at higher prices (eg A$88 on Berlusconi or A$372 on Dark Shades). However, airsoft weapons (*n*=14) were the most expensive (mean=A$1,043; median=A$695); this may be due to their potential for conversion to lethal versions (Florquin & King 2018: 12).

Average and median costs of digital products were the lowest (median=A$3.10) among weapon categories. The *Anarchist cookbook* (*n*=29), for example, was available for between $A1.45 and $A8.70. As noted previously, a completed 3D printed model Beretta 70 was available on Berlusconi for A$561 (versus the actual weapon at A$758–A$1,061 or only the 3D software file at A$77) and was classified as a digital product although it is also a replica firearm.

The Mann–Whitney test suggested no significant price differences between omnibus and niche markets for firearms (*U*=202,942, *p*-value=0.07). However, tests on differences in the listing prices for each firearm category showed that niche markets had significantly higher prices for rifles (n=66, median=A$1,630) compared with omnibus markets (*n*=152, median=$1,157) (*U*=3,784, *p*-value=0.002). Omnibus markets listed more expensive submachine guns (*n*=29, median=A$2,525) compared with niche markets (*n*=12, median=A$1,109) (*U*=278, *p*-value=0.002).

Vendors

Vendors were identified by both their total listings and the estimated value of their advertised weapons, although we did not measure sales. This approach identifies highly active vendors and potential targets for further investigation. Several vendors with similar aliases were merged as likely matches if they had a probability score greater than 0.876 calculated using the Jaro–Winkler method (van der Loo 2014).

Excluding the 12 niche markets, we identified 203 unique vendor handles or pseudonyms selling illicit firearms and other weapons on omnibus markets over the data capture period. Eighteen of these traders operated across two or more omnibus markets. During the study, 169 omnibus vendors ceased listing firearms and weapons and 67 new vendors began listing them on omnibus markets. However, only 34 were active at the end of the study due to the closure of some omnibus markets and weapons bans by Empire and Nightmare. Details about most vendors were usually absent, although 49 vendors provided some details about shipping, buyer feedback or the number of sales transactions. The number of purported sales was available on some omnibus markets but it was not possible to distinguish the value of SALW and other weapons actually sold because most vendors sold other products as well as SALW and other weapons.

Of the 49 vendors who provided details about location and shipping, four also operated across two or more omnibus markets and two listed only firearms. Most of these vendors (*n*=37, 75.5%) claimed to ship worldwide, eight (16.3%) claimed to ship worldwide from multiple locations, two (4.1%) only shipped locally and two (4.1%) provided no details. Twenty-seven vendors claimed to ship from the United States (55.1%), 12 (24.5%) from Europe, one (2%) from Australia, one (2%) from Russia; and eight did not indicate a location (16.3%). Most vendors promised stealth packaging to ensure products reached their destination and some gave brief descriptions. For example, 'Firearms72' stated: 'All the weapons will be sent disassembled, in different packs with different mail carriers. The weapons will come with an assembly guide. It will take around 20 minutes for you to assemble the weapon.'

Most vendors offered only a few products valued under A$5,000; however, four highly active vendors provided a variety of firearms or other weapons. The potential value of their listings exceeded A$100,000. Table 3 sorts and ranks all 215 vendors (including niche) into relative value and listing frequency. For example, the nominal total value of the most active vendor ('Davidmueller001') was estimated to be A$293,070, and this vendor also advertised more handguns than all other vendors (*n*=175, 11.7% of all handguns available). The next most active vendor's listings ('Goblin_King') were estimated to be valued at A$169,471, followed by 'fakefiles' at A$141,856 and 'Matt_1034' at A$121,615, with all other vendors valued under A$100,000 (see Table 3). Twenty vendors (including three niche vendors (Luckp-47, Guns & Ganja, and The Armory) accounted for 66 percent of the estimated A$2.494m value of all markets.

Table 3: Vendor activity by number of unique weapon listings and estimated value

	Estimated value (A$)			
Number of unique products	High >$100K	Medium $30K–100K	Low–medium $5K–29K	Low <$5K
High (>60)	3 (1%)	6 (3%)	0 (0%)	0 (0%)
Medium (30–60)	1 (0%)	10 (5%)	0 (0%)	0 (0%)
Low–medium (5–29)	0 (0%)	4 (2%)	33 (15%)	18 (8%)
Low (<5)	0 (0%)	0 (0%)	5 (2%)	135 (63%)

Note: The vendor distribution matrix is based on distinct vendors, including 12 niche vendors (*n*=215)

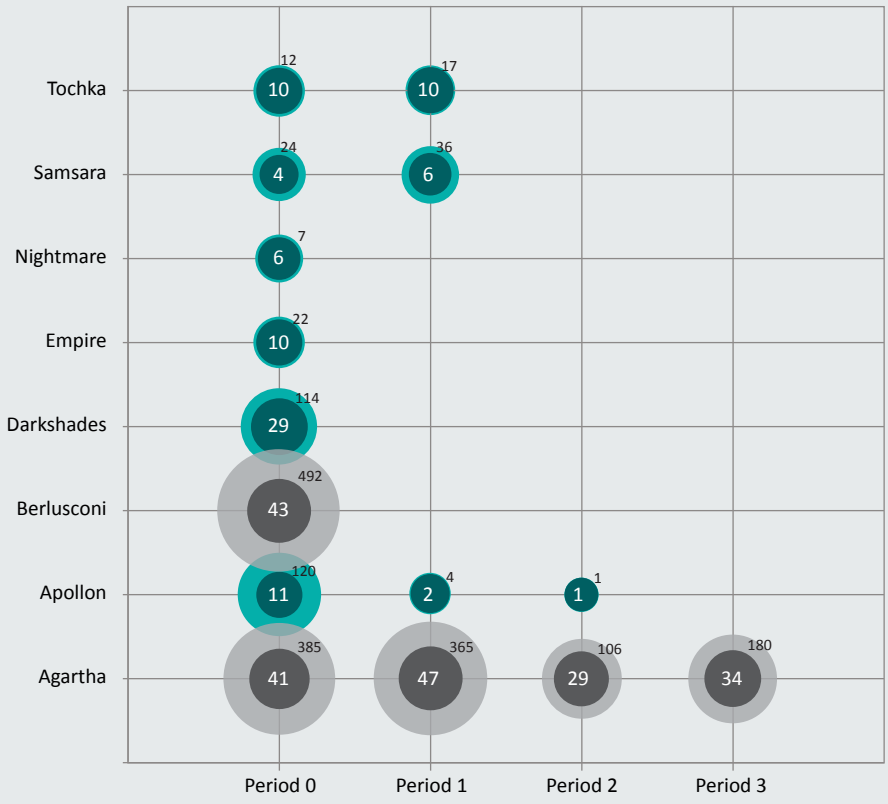
Market seizures and closures

Darknet omnibus markets are typically volatile and, as noted, five of our eight markets closed over the 22 weeks of this study. In contrast, all 12 niche markets continued to operate with little variation in listings or prices and no downtime or closures observed.

Berlusconi was a significant market and its seizure by the Italian Guardia di Finanza led to vendors shifting to Agartha as the largest remaining source of weapons on omnibus markets. We explored changes in the availability of weapons over four time periods defined by market closures. The seizure of Berlusconi had the largest impact, with a subsequent decline in the availability of weapons. With each omnibus market's closure, the number of weapons available and active vendors declined, although a modest recovery after the closure of Tochka was observed as follows (depicted in Figure 5):

- Period 0 (8 July – 28 September)—1,176 listings and 154 active vendors until Berlusconi's closure;
- Period 1 (29 September – 8 November)—422 listings and 65 active vendors until Samsara's closure;
- Period 2 (9 November – 28 November)—107 listings and 30 active vendors until Tochka's closure; and
- Period 3 (29 November – 20 December)—180 listings and 34 active vendors until the end of data collection.

Figure 5: Omnibus market vendor activity by number of unique weapon listings over time



Note: The inner circles represent the number of vendors in each omnibus market across four time periods and the outer circles represent the corresponding unique listings. In this figure, we consider the distinct vendors in each market across four periods and include cross-market vendor activities so the number of vendors exceeds the number of unique vendors

After the seizure of Berlusconi, 43 vendors formerly active on that market and other sellers across omnibus markets discontinued offering weapons. Apart from Agartha, all markets lost listings and sellers. After Samsara's closure the decline in active vendors continued. At the end of the collection period no new vendors offered firearms and weapons on the remaining markets of Agartha, Apollon and Empire.

Tracking vendors over time and across markets is fraught as assumptions about the relative permanence of either vendor aliases or Pretty Good Privacy (PGP) encryption keys are difficult to test. This problem is amplified because we did not capture all active Tor markets and so vendors may enter from untracked markets and can change their aliases and PGP keys at will.

We noted over the course of the study a number of previously unidentified vendors added listings to the surviving markets. Few vendors migrated to the remaining markets following each closure event. This may be due to increased forensic awareness among vendors about the risks of switching to another market without changing aliases or PGP keys. While some weapons vendors switched to Agartha after Berlusconi's seizure, none were very active players. SALW vendors provided less detail than vendors listing other products. Basic details such as shipping and location were available for less than a quarter of omnibus vendors. Given the demise of Berlusconi, and prior to this study the seizure in April 2019 of the well-known Wall Street market due to law enforcement operations, we found that darknet players respond to such closures by avoiding risk and adapting their operational security (Broadhurst et al. 2021). Law enforcement investigations of the darknet trade in SALW that focus on high-risk vendors and markets can disrupt supply, but niche markets also need to be targeted.

Despite the relatively few SALW available compared to other online illicit activity, the sale of explosives such as RDX and weaponised synthetic opioids such as carfentanil suggest the need for close monitoring of trends in the availability of these rare but dangerous products on darknet markets (Broadhurst, Ball & Trivedi 2020). We observed listings of ammonium nitrate, bromine and omethoate amongst other chemicals of concern on the omnibus markets still active at the time of writing, and further exploration of the presence of CBRN weapons is warranted.

Conclusion

This paper builds on earlier studies by Paoli et al. (2017), Rhumorbarbe et al. (2018) and Copeland, Wallin and Holt (2019) and like these studies also observed a small but notable illicit SALW trade on the darknet. By including both niche SALW and omnibus markets we observed how these small specialist markets avoid the volatility of 'High Street' markets and function 'under the radar'. Noting differences in collection periods and the number and combination of omnibus and niche markets analysed, this study identified more firearms and other weapons than previous studies. Darknet markets are volatile and evolving criminal enterprises. Vendors and buyers are not reliant on a single omnibus market and niche markets offer a credible and persistent alternative. Transnational law enforcement operations similar to the US and European Joint Criminal Opioid and Darknet Enforcement (J-CODE) task force (established in 2018 to suppress the darknet trade in opioids, especially fentanyl) are required to signal risk to darknet actors trading in SALW and CBRN and help steer markets to ban their sale.

Omnibus markets frequently ban the sale of illicit weapons, although vendors may circumvent these controls by using different or obfuscated names, descriptions and images. Also, many popular drugs adopt the names of weapons, especially firearms, increasing the risk of over-counting the number of weapons available. Both practices cause problems in the accurate identification and classification of illicit firearms and weapons and the process cannot be automated readily.

Illicit handguns, notably Glocks (and similar styled semi-automatic pistols), were the most available firearm on the darknet and are also widely available on licit markets. These are preferred due to their light weight, ease of disassembly and stealth packaging, although the polymer frame can be detected if x-rayed. The Glock's modular structure enables some its components to be sourced legally and locally to complete the assembly of an illegal firearm.

Overall, the darknet illicit SALW and other weapons market remains small when compared to both the global trade in SALW and other illicit activity on the darknet. Nevertheless, it provides access to firearms for those whose criminal networks have limited access to a key tool in the business of crime.

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URLs correct as at November 2020

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Appendix

Table A1: Firearm classifications

Darknet classification	NFA licence categories (2017)[a]	Customs (Prohibited Imports) Regulations subsection[b]
Rifles		
Automatic	D (a)	1 (e) (f) exclusion
Semi-automatic	C (a) /D (a)(c) (d)	3 (a) (b) / 6 (a) (b)
Bolt-action	A (b) /B (b)	1 (c)
Break-action	A (c)	2 (c)
Lever-action	B (d)	3 (c)
Break-action shotgun/rifle combination	B (c)	2(e)
Handguns		
Automatic	H	9 (e) (f) exclusion
Semi-automatic	H	9 (a)
Revolver	H	9 (a)
Submachine guns	D (a)	1 (e) (f) exclusion
Shotguns		
Break-action	A (c)	1 (d)
Semi-automatic	C (b)/D (c)	3 (a) (b) / 6 (c)
Pump-action	C (b)/D (c)	3 (a) (b) / 6 (d)
Miscellaneous (airsoft)	A (a)/H (a)	1 (a)(b) /9 (c)

a: 1. Centrefire or rimfire ignition distinctions are not found in sellers' descriptions on darknets but are relevant to Australian import regulations. Rimfire firearms are less common than centrefire, and can be identified by inspection of the firearm. 2. Many variants of firearms are found: manufacturers produce in metric or imperial, short or long barrels, automatic or semi-automatic and chambered for different calibre ammunition. Civilian versions of military assault rifles (eg the Colt AR-15) may be convertible to select-fire. 3. Australian law prohibits magazines of more than five rounds for shotguns and more than 10 rounds for rifles/handguns

b: Customs Import Regulations exclude any fully automatic (select-fire) weapon or those that are of the same 'appearance' and may prohibit attachments such as scopes and silencers

Roderic Broadhurst is Professor of Criminology at the Australian National University's School of Regulation and Global Governance and Director of the Australian National University's Cybercrime Observatory.

Jack Foye is a Research Intern at the Australian National University's Cybercrime Observatory.

Chuxuan (Jessie) Jiang is a former Research Assistant at the Australian National University's Cybercrime Observatory and the Research School of Finance, Actuarial Studies and Applied Statistics.

Matthew Ball is the Laboratory Coordinator of the Australian National University's Cybercrime Observatory.

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GPO Box 1936
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