



European Monitoring Centre
for Drugs and Drug Addiction

Cryptocurrencies and drugs: Analysis of cryptocurrency use on darknet markets in the EU and neighbouring countries

Background paper commissioned by the EMCDDA

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This report was prepared before Hydra Marketplace was closed by a joint law enforcement effort involving multiple US and German agencies. In August 2022, it was too early to say what impact its closure will have on the darknet market (DNM) ecosystem.

As this report illustrates (see Section 2.2), Hydra Marketplace was the primary site in the DNM ecosystem in recent years. Its removal will undoubtedly affect the use of DNMs, but past closures of this sort suggest that the effects will likely be short lived (Décary-Héту and Giommoni, 2017; Van Buskirk et al., 2017; Van Buskirk et al., 2014). While Hydra was a market of primary importance from 2020 to early 2022, the same could have been said for Silk Road in 2011 to 2013 or AlphaBay in 2017 at the time of their closures. In each case, activity within the DNM ecosystem recovered rapidly, as users migrated to other sites (ElBahrawy et al., 2020; van Wegberg and Verburgh, 2018). Figure 1 illustrates these drops and the recovery of activity in stark detail.

Other markets in the ecosystem could readily absorb former Hydra Marketplace users after its closure. According to Chainalysis data, 67 markets were waiting in the wings during 2021, including Flugsvamp Market 3.0, Iceteam, World Market and ASAP Market. One or more of these will probably capture much of the revenue and transaction activity that was formerly held by Hydra. The recovery might take time, and some users may migrate to peer-to-peer exchanges (see Figure 15 in Section 6), but there is nothing to suggest that this time will be different. Continued monitoring will be key.



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Contents

Key findings.....	4
Introduction.....	5
1. Methodology.....	6
2. Past and present aggregate market trends at global level	8
2.1. Summary.....	8
2.2. Introduction	8
2.3. Global market trends 2011-2021	8
2.4. Top darknet markets in 2021	10
2.5. Transaction flows	12
3. Trends in DNM activity by region	14
3.1. Summary.....	14
3.2. Introduction	14
3.3. Regions in cross-sectional comparison	15
3.4. Regions in a longitudinal comparison	16
3.5. Countries within regions: A first look at per capita sent and received activity	17
4. Trends in DNM activity by country	19
4.1. Summary.....	19
4.2. Introduction	19
4.3. The European Union.....	19
4.4. The UK+NO+TR regional grouping	21
4.5. The EU's Southern Neighbourhood.....	21
4.6. The EU's Eastern Neighbourhood	22
4.7. The Western Balkans.....	23
4.8. Russia	24
4.9. Hydra Marketplace.....	25
5. Legal frameworks.....	26
5.1. Summary.....	26
5.2. Introduction	26
5.3. The broad contours of legal rules across 54 countries.....	26
5.4. Regional and country examples.....	27
The European Union.....	27
Germany	28
Malta	28
Estonia	28
Romania.....	29

Sweden	29
The EU's Southern Neighbourhood	29
The EU's Eastern Neighbourhood	30
Western Balkans	30
6. Policy implications	31
Glossary of terms	33
References	34
Annex	36

The countries in this report are aggregated into six blocks: the European Union (EU); the United Kingdom, Norway and Turkey (UK+NO+TR); the EU's Eastern Neighbourhood; the Western Balkans; the EU's Southern Neighbourhood; and Russia, which is treated as a standalone regional and country-level unit due to its outsized role in the DNM ecosystem at the time of the study, as follows:

1. The EU includes Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden.
2. The UK, NO, TR grouping includes the United Kingdom, Norway and Turkey.
3. The Eastern Neighbourhood grouping include Armenia, Azerbaijan, Georgia, Moldova, Belarus and Ukraine.
4. The Western Balkan region includes Albania, Bosnia and Herzegovina, North Macedonia, Kosovo* (*This designation is without prejudice to positions on status and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence), Montenegro and Serbia. Data on Kosovo are not available in the Chainalysis dataset, and this country is not included in the analysis below.
5. The EU's Southern Neighbourhood includes Algeria, Egypt, Israel, Jordan, Lebanon, Libya, Morocco, Palestine (this designation shall not be construed as recognition of a State of Palestine and is without prejudice to the individual positions of the Member States on this issue), Syria and Tunisia. Palestine does not have population data available via the World Bank, so it is excluded from all per capita analysis.
6. Russia is not a part of the EU's Eastern Neighbourhood but is included in the report due to its general geographical location (eastern Europe/Eurasia) and relevance to the Darknet market ecosystem.

Key findings

This report uses data from Chainalysis(1) to estimate the degree of activity in the darknet market (DNM) ecosystem (from 1 June 2011 to 31 October 2021) and triangulate these activities collated to the countries of the European Union and its surrounding neighbours (54 countries in all; from 1 April 2019 to 1 June 2021). The report also provides a discussion of the constantly evolving legal environments that govern cryptocurrency use in some of these countries.

The key findings from the analysis are given below.

- The DNM ecosystem has grown significantly since its inception in 2011.
- After the early and rapid expansion of the DNM ecosystem in 2011-2013, growth continued but was periodically interrupted due to market volatility.
- At any point in time, most activity in the DNM ecosystem is clustered in one or two major markets.
- The euro-to-transaction ratio has been increasing over time, which suggests a move towards larger volume or higher priced purchases on DNMs.
- The euro-to-transaction ratio increased significantly around June 2017, which corresponds with Operation Bayonet that closed the AlphaBay and Hansa DNMs.
- Regions have sizable differences in total revenue engagement with DNMs. The EU, the UK+NO+TR grouping, the Eastern European Neighbourhood and Russia account for many times more activity than the Western Balkans and the EU's Southern Neighbourhood.
- All regions show a similar pattern. Revenue sent to DNMs is typically less than that received back from these wallets. This suggests that there is regional variation in the volume of engagement with DNMs but not pronounced regional-level differences in role (i.e. buying regions, selling regions, admin regions, etc.).
- Over the observed time range, most regions have exhibited a growth in their revenue engagement (both sent and received) with DNMs, with the exception being the Western Balkans.
- Nineteen EU countries, three countries in the EU's Eastern Neighbourhood, Russia and Montenegro from the Western Balkans could be considered sizable players in the DNM ecosystem.
- In per capita terms, the three countries that show the most engagement with DNMs are in the EU: Latvia (highest overall), Luxembourg (highest receiving country) and Sweden (highest sending country).
- Within each region, there are notable gaps between the most engaged and least engaged countries (except the single-country Russian grouping).
- In terms of economic engagement, the regions can be divided into mature (EU, Eastern Neighbourhood, UK+NO+TR and Russia) and immature (Southern Neighbourhood and the Western Balkans) areas, with notable differences in the relationship between the most active countries within each subset.
- The countries with the highest level of total per capita revenue engagement with DNMs in most regions also showed little additional growth in activity during the 1 April 2019 to 1 June 2021 period, which suggests the potential for market saturation or regression to the mean dynamics.
- Exchanges are a common way of initially obtaining cryptocurrency to fund on-chain wallets.
- Exchanges governed by know-your-customer (KYC) and anti-money laundering (AML) rules are typically required to obtain real identity documents from clients, so that law enforcement can trace transactions from DNMs to real-world individuals.

(1) Chainalysis is a private company that provides data, software, services and research to government agencies, exchanges, financial institutions, and insurance and cybersecurity companies about data stored on the blockchain.

- Not all countries in the sample have KYC and AML rules in place for exchanges working within their jurisdictional boundaries.
- Some national rules are inconsistent in design or application, which creates the possibility of a patchwork regulatory regime.
- Eight of the 54 countries (~15 %) in the sample have outright bans on cryptocurrencies, yet engagement with DNM continues in these locations, particularly among those in the EU's Southern Neighbourhood.

Introduction

Darknet markets (DNMs), which combine the online anonymity-granting functions of Tor with traditional trust-building e-commerce trappings (e.g. vendor rating systems), have become a small but non-negligible proportion of the global drug market (Soska and Christin, 2015; EMCDDA-Europol, 2017). By linking buyers and sellers of illicit drugs via the internet, DNMs overcome some of the restrictive elements of traditional drug markets. Typical offline drug exchanges are largely tethered to physical space and usually require some degree of interpersonal interaction between buyers and sellers. In contrast, DNMs happen in the largely anonymous, borderless, asynchronistic online world of the Dark Web (Martin, 2014a, 2014b). By obfuscating the identity of participants and partially untethering drug exchange from the geographical location of participants, DNMs make tracing the flow of drug revenues and illicit goods between countries a challenge. Yet understanding these trends remains important for the development of supply-side and demand-side drug policies.

The anonymity that is at the core of DNMs contrasts with the functional legibility of cryptocurrency blockchains. Blockchains are public ledgers that contain a permanent record of transactions between pseudo-anonymous wallet addresses. While the addresses themselves are 17-34-digit alphanumeric strings, people, groups and institutions operate behind these digital identifiers. If the identity behind the address can be determined or an address can be linked to an illicit activity, then all transactions undertaken by that wallet (i.e. money sent or received) can be observed. This allows for an extremely accurate record of the flow of revenue. Since DNMs use cryptocurrencies, particularly Bitcoin, as their medium of exchange (Martin, 2014b), the legibility of the blockchain enables an estimation of the flow of value to and from DNMs. These estimates can be made overall and, with some additional assumptions and data, by country or regionally.

In this report, we use Chainalysis data to trace engagement with DNMs overall (from 1 June 2011 to 31 October 2021) and in the European Union and its surrounding countries (from 1 April 2019 to 1 June 2021) ⁽²⁾. The countries in this report are aggregated into six blocks: the European Union (EU); the United Kingdom, Norway and Turkey (UK+NO+TR); the EU's Eastern Neighbourhood; the Western Balkans; the EU's Southern Neighbourhood; and Russia, which is treated as a standalone regional and country-level unit due to its outsized role in the DNM ecosystem at the time of the study.

The report is divided into six parts. The first section provides an overview of the data collection methodology and focus of the report. The second section summarises activity in the wider DNM ecosystem, with an emphasis on the global trend in DNM revenue from 1 June 2011 to 31 October 2021, the trend in sent or received cryptocurrency by market during a shorter time interval (1 January 2021 to 31 October 2021), and trends in transaction ratios from 1 June 2011 to 31 October 2021. The third section focuses on the flow of cryptocurrencies to and from DNMs by region. It provides the first glimpse at how these sites are used within the EU and its surrounding areas. This section details the total cross-sectional revenue comparisons between regions, over time trends in revenue engagement with DNMs by region, and an initial disaggregation of regions and countries in total sent and received DNM revenue. The fourth section unpacks country-specific trends in revenue engagement with DNMs,

(2) The overall and geographically specific trends leverage different collection methodologies (see the Methods section below) and thus have different, but overlapping, time frames.

organised around each regional block. The fifth section presents a summary table of the prevailing legal context in each country, and selected country and regional case studies. The final section offers supply-side and demand-side policy recommendations based on the results of the data analysis.

1. Methodology

This report leverages a combination of data from on-chain (i.e. data from the blockchain) and web traffic (i.e. IP-based site visitor information) sources. The latter are taken from a third-party vendor called Similar Web. The report uses these data to assess the prevalence and severity of DNM-related cryptocurrency activity and, with some limitations, its geographical pattern in and around the European Union (EU). Despite the transparency of the blockchain, estimating the flow of cryptocurrency precisely is often an exercise in false precision. Due to the decentralised nature of cryptocurrency and the availability of obfuscation technologies such as mixing services, it is difficult, if not impossible, to know the true amount of cryptocurrency usage associated with a particular service (i.e. DNM) or a specific country. While we exclude DNMs that are nominally oriented toward fraud or the sale of digital goods, our estimation of cryptocurrency activity likely does include more than just drug-related sales, even though the bulk of activity on the markets in the sample are for drugs. In short, our methodology provides approximate, yet directionally correct estimates of the volume of flows and an ordinally correct comparative ranking between geographical locations.

To show how this is done, we first introduce a concept unique to Chainalysis called ‘indirect exposure’. Chainalysis has an algorithm called ‘indirect exposure’ that calculates the paths funds take between services. For example, a darknet market vendor may send cryptocurrency through thousands of wallets before the funds hit an exchange. Chainalysis traces all the paths these funds take until they hit a known service. In this context, we analyse the services used by darknet market vendors, to identify a geographic footprint. Many services have a strong geographic footprint. This might be for banking reasons, language reasons or even due to network effects. We exploit this fact and assume that the geographic footprint of the funds emanating from DNM services is a proxy for the location of the users and vendors on marketplaces.

We calculate the country-level estimate of cryptocurrency value based on observed service-level activity used by DNM participants, multiplied by the share of a service’s web traffic from a particular country in a given month. All activity belonging to a country is then summed or divided over a given time scale (e.g. years, months or days). These estimates are then assessed relative to the time zone of the platforms’ cryptocurrency activity, the fiat currency pairs offered by the exchange, the website language options and the location of the platform headquarters. We then merge these data with on-chain data estimating flows to specific categories of cryptocurrency wallets, such as those associated with DNM activity.

This combined approach to estimating the pattern of illicit cryptocurrency activity and the geographical flow of value to and from DNMs has some limitations. The estimation of the flows has at least four caveats. First, the approach is restricted to observed on-chain data, meaning that activity of interest that does not occur via the blockchain will not be recorded. For example, if buyers and sellers on a DNM opt to ‘go direct’ and employ an alternative payment scheme (e.g. Venmo transfer, a prepaid gift card or even cash), then this activity would not be recorded in our data collection (Childs et al., 2020; Jardine, 2021; Moyle et al., 2019). Second, we do not capture cryptocurrency trading volume when someone purchases cryptocurrency with fiat currency and keeps it on an exchange, trades on an exchange or cashes out on an exchange. This activity is not recorded on the blockchain, but is recorded in the private order books of exchanges. Third, with limited exceptions (LocalBitcoins and Paxful), we do not account for other off-chain data that might be related to peer-to-peer exchanges. Finally, when we estimate the flow of value to and from cryptocurrency wallets associated with DNMs, these estimates will include some proportion of activity that is not necessarily drug-related, such as the purchase or sale of armaments, hacking tools, identity credentials and so forth. That being said,

DNMs have historically been heavily weighted toward drug transactions so the bulk of observed activity likely comes from this sort of commercial activity (Christin, 2013; Soska and Christin, 2015), though this balance seems to be diminishing over time (EMCDDA and Europol, 2017).

The estimation of the geographical dispersion of DNM activity likewise has its limits. First, the relationship between web searches and cryptocurrency activity is not equal (it is a best estimate but still an estimate). Secondly, web traffic data do not account for VPN usage: at times we pick up a different country to where a person actually is, due to the geolocation of the VPN exit node. Third, because we apply web traffic shares regardless of transfer size, we likely underestimate users in a country that makes large transfers. A final limitation is that not all potential areas of interest, such as Kosovo, are included in the geographical dataset, though coverage remains fairly comprehensive.

Overall, while the data collection methods used in this report have limits, the resulting data are likely to be valid in two crucial ways. First, the direction of the data is likely correct, meaning that a recorded increase in DNM cryptocurrency activities in Sweden over a period of time, for example, is likely representative of a real increase, even if the precise magnitude of the change is potentially biased. Second, it is likely that the estimations of country flows in the current data are biased to similar degrees, with some potential for undercounting in countries within the EU's Southern Neighbourhood where internet infrastructure might be marginally lower. The implication is that rankings of DNM cryptocurrency flows by country or region likely capture the true rank ordering of things, even if the precise interval distance between any two countries is likely subject to some degree of uncertainty.

2. Past and present aggregate market trends at global level

2.1. Summary

- The DNM ecosystem has grown significantly since its inception in 2011.
- The early and rapid rate of expansion of the DNM ecosystem has slowed since 2011-2013.
- At any one point and time, most activity in the DNM ecosystem is clustered in one or two major markets.
- The euro-to-transaction ratio is increasing over time, which suggests a potential move toward larger volume (or higher priced) purchases and sales on DNMs.
- The euro-to-transaction ratio increased significantly around June 2017, coinciding with Operation Bayonet that closed the AlphaBay and Hansa DNMs.

2.2. Introduction

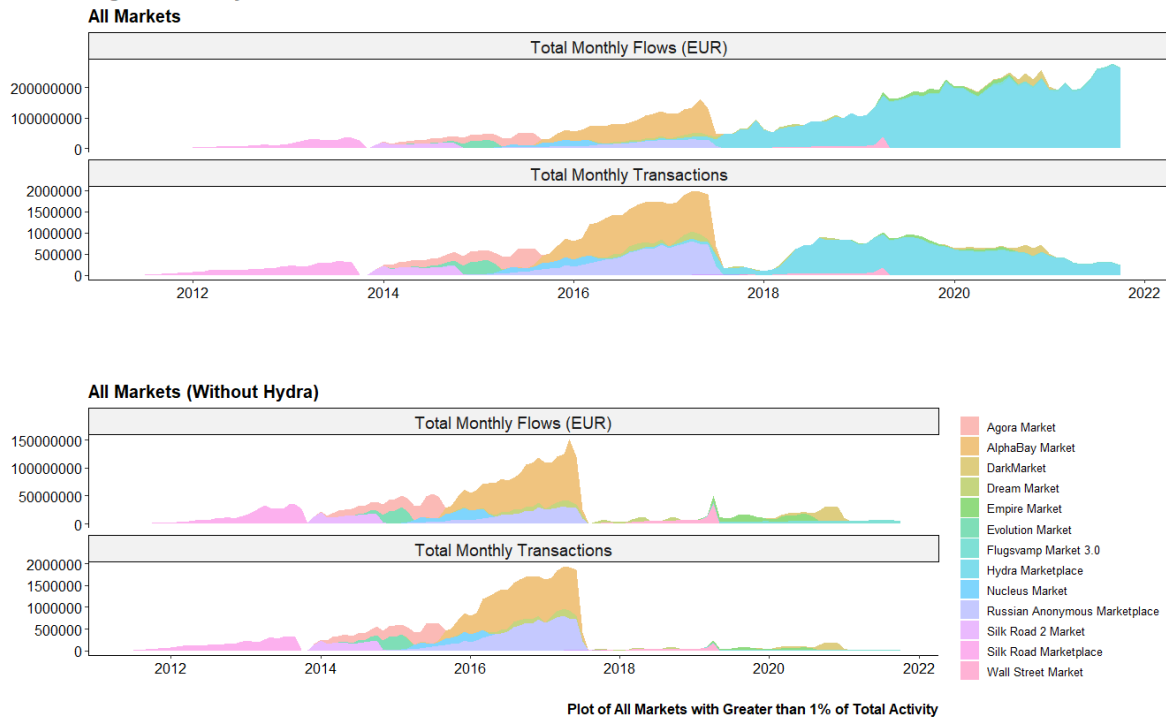
This section broadly summarises the observed trend in DNM activity at global level. The first subsection summarises long-term trends in the DNM ecosystem by market from early 2011 until 2021. The DNM ecosystem contained 127 distinct nominally active markets during this time. However, users, vendors and drug exchange activity tend to cluster towards a few dominant marketplaces in each epoch (ElBahrawy et al., 2020) and market closures happen frequently (Décary-Héту and Giommoni, 2017; Soska and Christin, 2015). Given this pattern, we present data in the first subsection only for the markets that made up over 1 % of the total share of revenue activity during the 2011-2021 period. A total of 13 markets within the dataset matched this criterion. The remaining 114 markets had revenue levels below this proportional threshold. Additionally, because activity clusters so sharply in a few markets and few markets persist for longer than a few years, we present in the second subsection the trend in sent and received activity for the top 15 markets during a shorter time frame (1 January 2021 to 1 June 2021). The third subsection presents the trend in revenue flows to observed transactions.

2.3. Global market trends 2011-2021

Figure 1 depicts the monthly trend in revenue flows and transactions for all 13 markets that made up at least 1 % of total revenue activity in the entire global DNM ecosystem from 2011 to 2021. To showcase the degree to which a single market dominated the DNM ecosystem at this time, the figure also plots the same market values for the period but without Hydra Marketplace, which was the largest market in operation during the study period.

The data shown in Figure 1 exhibit four patterns. First, over this longer period, the volume of market revenue and transactions within the darknet ecosystem increased significantly more than in the early days of the Silk Road (Christin, 2013; Soska and Christin, 2015). According to these data, the total population of DNMs in 2011 transacted approximately EUR 6.7 million. In 2020, the last year for which full data are available, DNMs collectively transacted EUR 3.145 billion, or around 469 times as much per year revenue throughput in just nine years. Transactions similarly increased significantly during this time, increasing from about 260 000 transactions in 2011 to about 12 million in 2020, which is a roughly 46.5-fold increase.

Figure 1. Ecosystem Wide Trends in DNM Revenue and Transactions, 2011=2021



The second trend of note is that the rate of expansion of the DNM ecosystem is slowing, as shown more specifically in Table 1 (see Annex). There are many potential reasons for the plateauing rate of growth. One might be the saturation of latent DNM users in countries with high levels of internet connectivity. Frequenting DNMs is a comparatively inconvenient way to procure drugs that requires a fair degree of technological sophistication, information accumulation and user socialisation to the norms of the space (Barratt et al., 2016; Chen et al., 2022; Maddox et al., 2016). These requirements are surmountable for many but may place participation in the darknet drug market space beyond reach for some, especially if basic physical requirements of use (e.g. a secure mailing address or reliable internet connectivity) are not readily available. Another contributory factor to the plateau could be the cumulative effect of numerous DNM closures by law enforcement. While individual closures have tended to cause only short-term disruptions to the ecosystem (Décary-Héту and Giommoni, 2017; Soska and Christin, 2015; Van Buskirk et al., 2017), the cumulative effect of these efforts might contribute to the emergent plateau in DNM activity that is observable from 2019-2021. Exit scams, as happened with markets such as Evolution or Dream, and voluntary closures might also limit the volume of activity in the ecosystem over time. Finally, period-over-period rates of growth should naturally decline as the size of the DNM ecosystem increases. At three-to-four billion euro of total transactional revenue, the DNM ecosystem is certainly so large now that maintenance of the early prodigious growth rates is unlikely, even without user saturation or potential cumulative deterrence effects (for evidence of country-specific plateaus, see Subsections 4.3 to 4.8). Interestingly, as explained in more detail in Subsection 2.4 below, the rate of revenue growth has far outpaced the change in transaction volume.

The third trend that is clearly evident from Figure 1 is that the darknet market ecosystem has only a few dominant markets at any particular point in time (ElBahrawy et al., 2020; Soska and Christin, 2015). While the data included some 127 distinct DNMs, only 13 had at least 1 % of the total ecosystem revenue and made up enough activity to warrant display. Earlier markets, such as the Silk Road, Evolution, AlphaBay and Dream, were preeminent in their time, but have long since closed, only to be replaced by other dominant players (ElBahrawy et al., 2020). As shown in Figure 1, a single marketplace (Hydra – teal blue in the figure) emerged as the primary market focal point in today's DNM ecosystem. Since its inception in late 2015, Hydra's yearly revenue increased from around

EUR 3 000 to closer to EUR 1.97 billion collectively sent and received in 2021. Expressed in proportional terms, these numbers suggest that Hydra Marketplace made up roughly 93 % of the total 2021 revenue in the DNM ecosystems. Indeed, when Hydra Marketplace is excluded from the graphic (see the second pane in Figure 1), the system appears to be largely plateauing. The figures without the dominant marketplace in each period illustrate that this current pattern of clustered use is a recurring feature of drug exchange in this environment. Hydra Marketplace was closed by a joint law enforcement effort, involving multiple US and German agencies in April 2022.

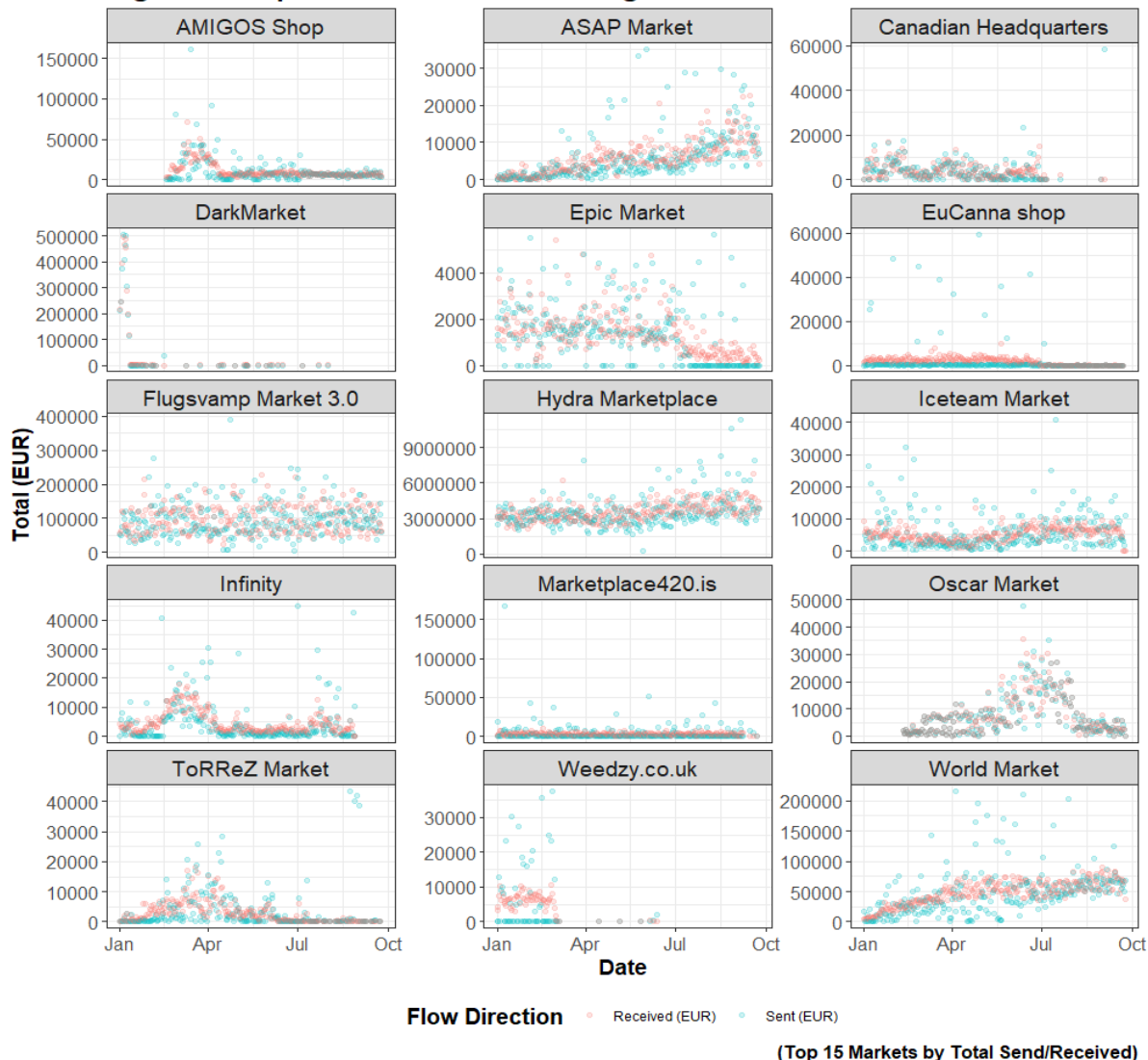
The patterns apparent in Figure 1 suggest a clear need to dive deeper into market-specific trends over shorter time scales (Subsection 2.3), since the big players effectively account for the vast majority of all revenue activity. They also indicate the need to explore the relationship between total revenue and transaction volumes over time in more detail (Subsection 2.4).

2.4. Top darknet markets in 2021

Figure 2 breaks down the market-specific trends in sent and received cryptocurrency for the 15 top markets during the course of 2021⁽³⁾. Some of these markets (e.g. Canadian Headquarters) are predominantly regional in their orientation and cater to buyers and sellers outside the EU and its surrounding areas. However, they still transacted sufficient revenues to rank within the top 15 markets globally in 2021 and they help to reveal what is happening in the DNM ecosystem at macro level.

(3) Select markets that tailor more toward sales of identity credentials or non-drug related goods are not included in this count of the top 15 markets' activity during this time period.

Figure 2 - Top 15 Darknet Market During 2021

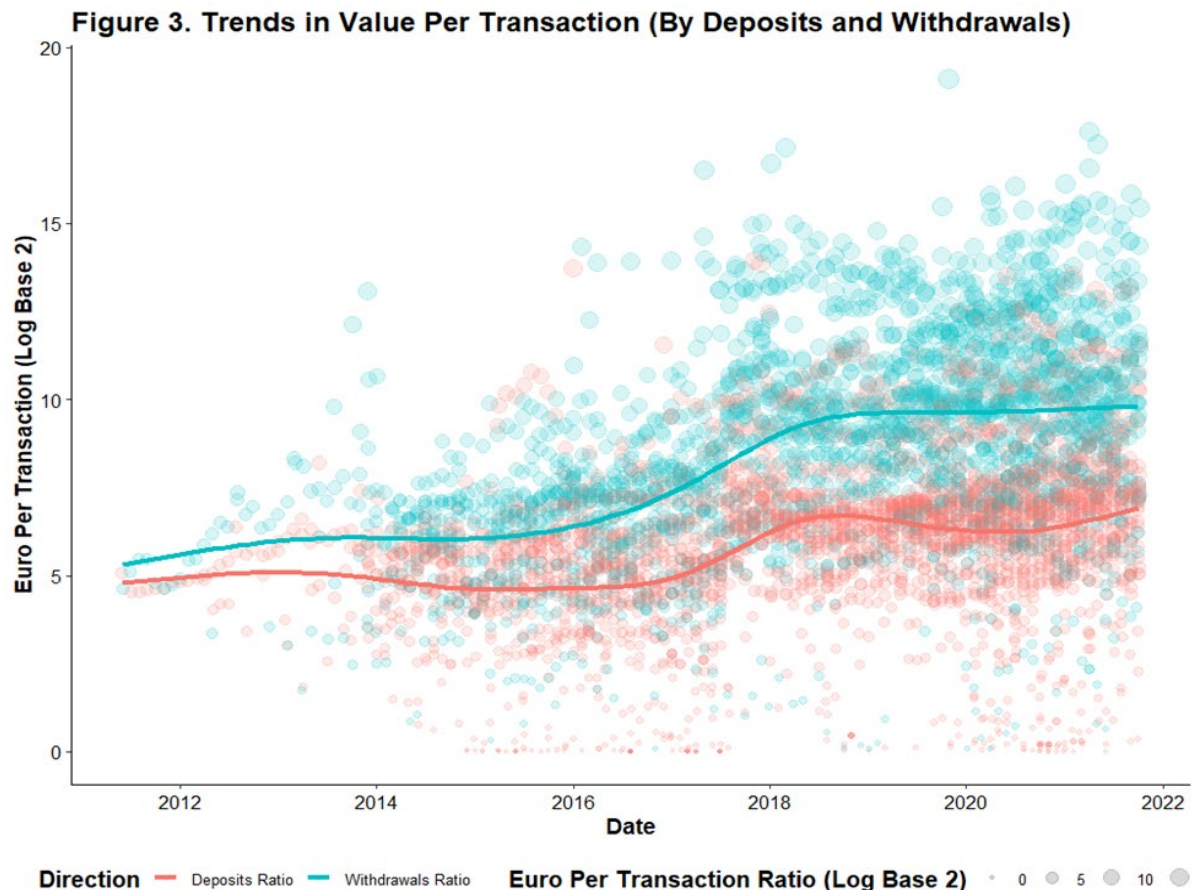


Two patterns are particularly evident from this more disaggregated temporal and cross-sectional analysis. First, a number of markets grew during 2021, such as Hydra (+10 % increase), ASAP Market (+1 028 % increase) and World Market (+ 299 % increase). While markets like ASAP and World Market have increased at the fastest rate of change, it is also abundantly clear (see Section 2.2) that Hydra Marketplace dominated the DNM ecosystem in terms of absolute value sent (EUR 949 037 246) and received (EUR 958 689 455) in 2021. Indeed, Hydra processed more revenue throughout this period than all the other top-15 markets in 2021 combined, and it captured 93 % of observed revenue activity.

The second trend of note in Figure 2 is that a few marketplaces, such as weedzy.co.uk and DarkMarket, experienced short-lived spikes in activity early in the year, followed by a collapse back toward inactivity. In both cases, this was due to law enforcement intervention. In early 2021, German police arrested DarkMarket’s main administrator in Germany (Butler, 2021). Weedzy was likewise shutdown by British police in January 2021 (Admin, 2021). One very tentative lesson from the fall of these markets is that success (when coupled with site administration errors) can breed failure. This is often due to increased law enforcement attention as a function of market size and rate of expansion. The law enforcement take-down of Hydra in April 2022 appears to confirm this.

2.5. Transaction flows

Figure 3 depicts the trend in two euro-to-transaction ratios within the DNM ecosystem. These ratios are the per month value of transactions (in euros) divided by the number of transactions per month. These measures essentially represent the euro value per transaction on DNMs over time. The separate measures capture both deposit (buyers) and withdrawal (cash outs by vendors or market admins) activity. Due to a few extreme outliers (e.g. one monthly euro-to-transactions ratio value of 555 596.6 that likely corresponds to an exit scam period), the figure presents the log (base 2) of the values of these measures. To avoid logging zeros, a small positive value (1) was added to all observations. The dots represent distinct market/month observations from June 2011 to October 2021. An overlaid loess trend line in the scatter plot illustrates directionality.



Three things are evident from the trend in the euro-to-transaction ratios plotted in Figure 3. First, the ratio data in Figure 3 show that the transactional behaviour of DNM participants changed part way through 2017, leading to decidedly higher euro-to-transaction ratios after around June or July of that year, before stabilising again at these higher rates. The most likely cause of this change is the closure of Hansa and AlphaBay markets during Operation Bayonet, which removed the largest markets in operation at the time. This joint operation also differed from previous market closures, in that AlphaBay was seized by the FBI while Hansa was being actively run as a honeypot by police in the Netherlands (Jardine, 2021). As users migrated from AlphaBay to Hansa (van Wegberg and Verburgh, 2018), Dutch law enforcement were able to record a variety of personal details about incoming users due to prior site reconfigurations. Knowledge of how Operation Bayonet unfolded could have prompted subsequent changes to user behaviour that had been previously unseen in the ecosystem.

The second evident trend is that the ratio of euros to both deposits and withdrawals, which represent the two sides of transactions on DNMs, are gradually increasing over time in both cases. Framed

differently, this trend shows that more euros are being spent per transaction on DNMs. For example, this trend implies that buyers (deposit ratio) spent more, on average, for each transaction with DNM cryptocurrency wallet addresses in 2021 than in 2011. The cause of this increasing expenditure could be a rise in larger volume drug-related purchases from DNMs. However, it could also be that buyers are purchasing more expensive drugs or that prices are cyclically increasing due to inflationary pressures.

To the extent that the ratio is increasing due to changes in buyer behaviour, greater purchasing revenue per transaction could be a risk mitigation strategy by buyers, who may view making fewer but larger purchases as a way to minimise the risk of arrest, particularly as the interdiction of drugs in the mail has led to a number of high-profile law enforcement operations (Jardine, 2021). Of course, larger purchases might be more likely to be intercepted, so buyers could be relying on an optimisation strategy that balances the number of transactions with the risk of buying larger volumes. Along the same lines, higher volume purchases could suggest that DNMs are being increasingly used for larger transactions meant for some combination of local social supply or redistribution (Aldridge and Décary-Héту, 2016).

The final pattern evident from the ratio data in Figure 3 is that withdrawals tend to be of a consistently higher ratio value than deposits. Three underlying reasons might account for this higher score. First, a single vendor might service multiple buyers over short time scales. In this process, DNMs might take in numerous, smaller denomination payments from buyers, store these funds in escrow, and then dispense a cumulatively larger sum to a vendor in fewer outgoing transactions. Second, DNMs usually take a fee to act as escrow (Hydra's commission was around 4 %, for example). If the DNM admins hold this money in their market wallets and then transfer it out to other addresses in larger sums, then these transfers would increase the observed euro-to-transaction withdrawal ratio. Finally, especially for funds taken by the DNM admins as commission, cryptocurrency price appreciation could result in higher outgoing than incoming euro-to-transaction ratios. For example, if a DNM's commission at the time of sale for a single transaction amounted to 10 euros, but then Bitcoin (BTC) appreciated 100 % before this money was moved out of the DNM wallets by the site admins, the observed ratio on the withdrawal of the funds would be twice as large as the deposit ratio for the same funds.

3. Trends in DNM activity by region

3.1. Summary

- Regional areas exhibit sizable differences in total revenue engagement with DNMs, with the EU, the UK+NO+TR grouping, the Eastern European Neighbourhood and Russia accounting for many times more DNM activity than the Western Balkans and the EU's Southern Neighbourhood.
- All regions exhibit a similar pattern where revenue sent to DNMs is typically less than that received back from these wallets. This suggests regional variation in the volume of engagement with DNMs but not pronounced regional-level differences in role (i.e. buying regions, selling regions, admin regions, etc.).
- Over the full observed time range, most regions exhibited growth in their revenue engagement (both sent and received) with DNMs, with the one potential exception being the Western Balkans.
- Nineteen EU countries, three countries in the EU's Eastern Neighbourhood, Montenegro and Russia could be considered sizable players in the DNM ecosystem.
- In per capita terms, the three countries that engage most with DNMs are all in the EU, including Latvia (highest overall), Luxembourg (highest receiving country) and Sweden (highest sending country).

3.2. Introduction

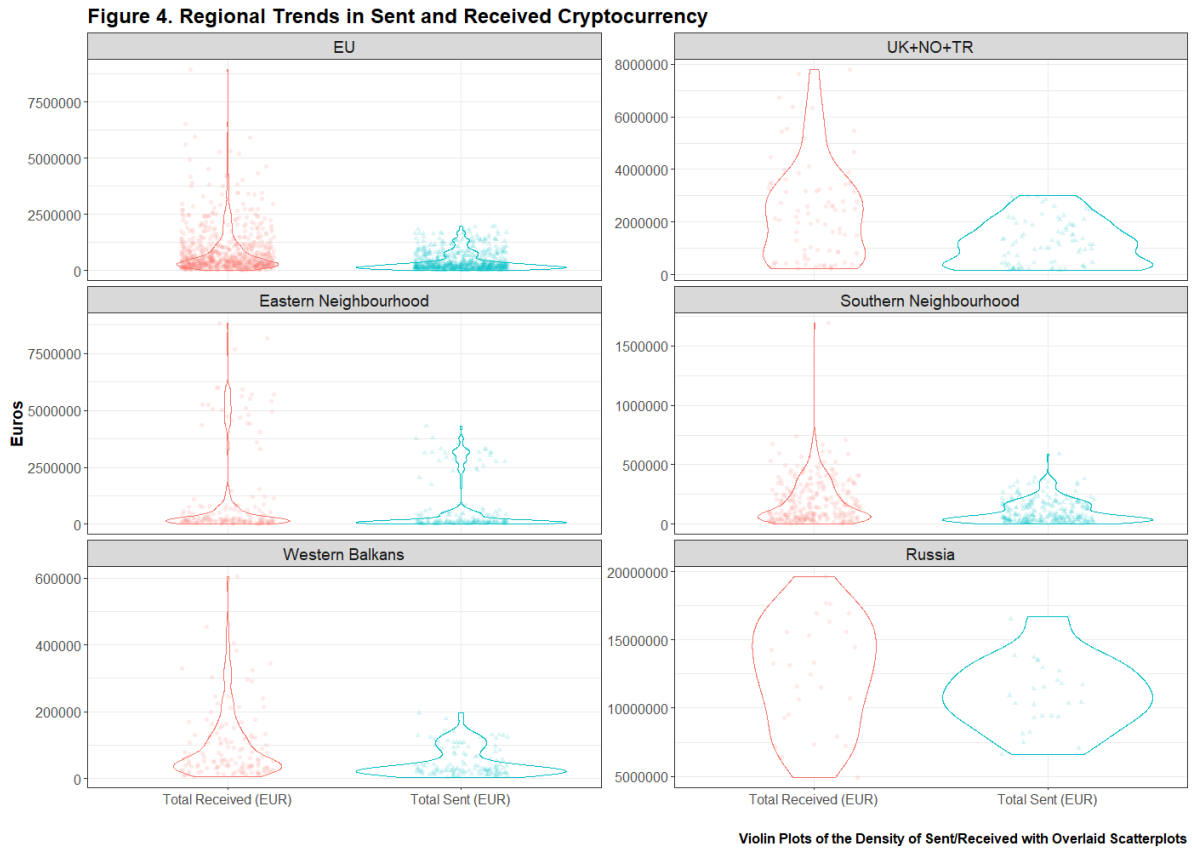
While DNMs connect buyers and sellers across national borders, users nevertheless remain localised to some degree. Buyers still need to have illicit drugs shipped to an accessible mailing address to complete an exchange. Vendors still need to send drugs from their location to the buyer – assuming they are not part of a dropshipping network. To ameliorate potential scams by either buyers or sellers, DNMs tend to stand in the middle of these deals and provide an escrow account facility, holding the cryptocurrency from a given transaction until the drugs have been shipped and the buyer confirms satisfactory receipt (Horton-Eddison and Di Cristofaro, 2017). However, market participants can also opt to 'go direct' (Childs et al., 2020; Moyle et al., 2019).

This typically three-part market structure implies a way to estimate the geography of DNM exchanges via the blockchain. Buyers should predominantly send cryptocurrency to DNM wallets, which will hold these funds in escrow. Vendors should predominantly receive cryptocurrency from DNM wallets once a deal is finalised, with some slippage to account for market fees, which might also flow from DNM addresses to the personal wallets of site administrators located in specific jurisdictions. Using the geographical estimation methodology detailed in Section 1, we traced cryptocurrency flows to and from the countries of the European Union (EU), the UK, Norway and Turkey (UK+NO+TR), Europe's Eastern Neighbourhood, the Western Balkans, Europe's Southern Neighbourhood and Russia. Unlike the data used in the previous section, the geographical collection methodology covers the time frame stretching from 1 April 2019 to 1 June 2021.

In the estimation of geographically specific DNM activities, we start in the first subsection by detailing cumulative sent or received DNM activity by regional grouping. In the second subsection, we carry out a cross-sectional and longitudinal comparison of the regions, to contrast sent and received DNM activity by region over time. The last subsection presents the first per capita comparison of regions and countries. It identifies areas that are significant focal points for DNM revenue engagement.

3.3. Regions in cross-sectional comparison

Figure 6 presents a set of faceted violin plots of sent or received cryptocurrency by region. In the figure, each dot represents a monthly observation for a country nested within a respective region and the boundaries of the violin plots show the density of the data points at each level of euros sent or received. Four patterns become apparent when we compare the regions in this way.



First, within five of the six regional areas, most countries in most months only sent or received comparatively small levels of revenue, given each region’s observed maximum revenue flows. The violin plots in the first five regional area panes in Figure 6 show this pattern with wide density boundaries at the lower end of the y-axis. Russia was a significant outlier, with the lowest monthly value being around 5 million euro, as opposed to roughly 0 for all other regions. In total, most countries in most regions exhibited comparatively low levels of DNM cryptocurrency activity most of the time, with episodic bursts to the contrary.

Second, all six regional areas tended to send cryptocurrency revenues to DNMs at lower country/month revenue volumes than those at which they received funds. This sent or received pattern by regional area could suggest that there are really two predominant types of DNM use. These are routine use, which would involve small-to-medium size regular purchases and sales and that would add up to comparatively low monthly rates of sending or buying activity, and large-scale exits, which could involve significant cash-outs by admins or major vendors and would aggregate to very large monthly sums of received cryptocurrency currency.

The third observation that can be made is that the absolute scale of DNM revenue activity varied considerably between regions. The summed maximum value sent and received in a month by all countries within the EU, for example, was EUR 194 620 195. In contrast, within the Western Balkans (the region with the lowest engagement), the similar total value sent and received in a given month was only EUR 1 308 052, or roughly 149 times less. The full summary statistics for each region by sent and received revenue flows are presented in Table 2 (available in the Annex).

3.4. Regions in a longitudinal comparison

The cross-sectional comparisons of regions reveal several things about each location’s engagement with DNMs, but such contrasts cannot pinpoint the trend in monthly activity over time. Figure 5 details the trend in average regional monthly flow of revenue over the full-time frame of the available crypto-by-regional grouping data. Figure 6 details the average monthly flow of revenue per 100 000 people during the 2019-2021 period, to correct for the idea that large population areas would naturally observe larger absolute flows, everything else being equal. A few trends are apparent in these plots.

Figure 5. Longitudinal Trends in Cryptocurrency by Region

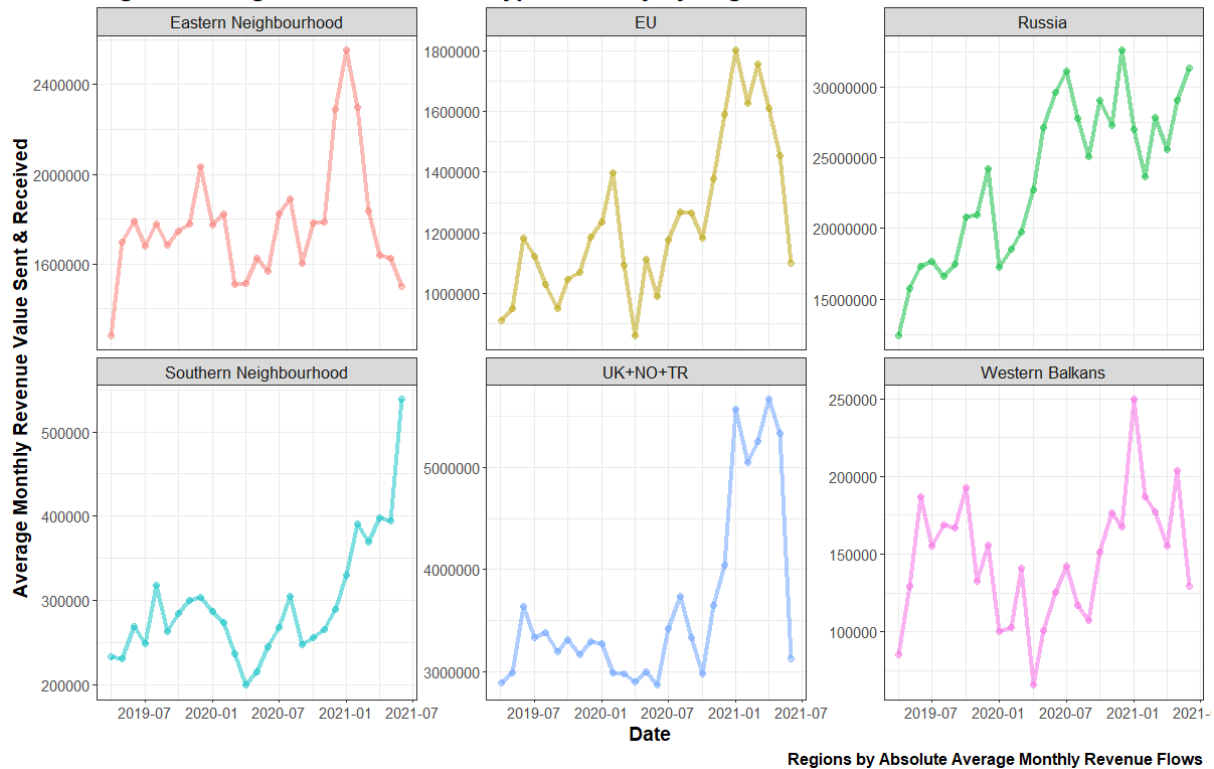
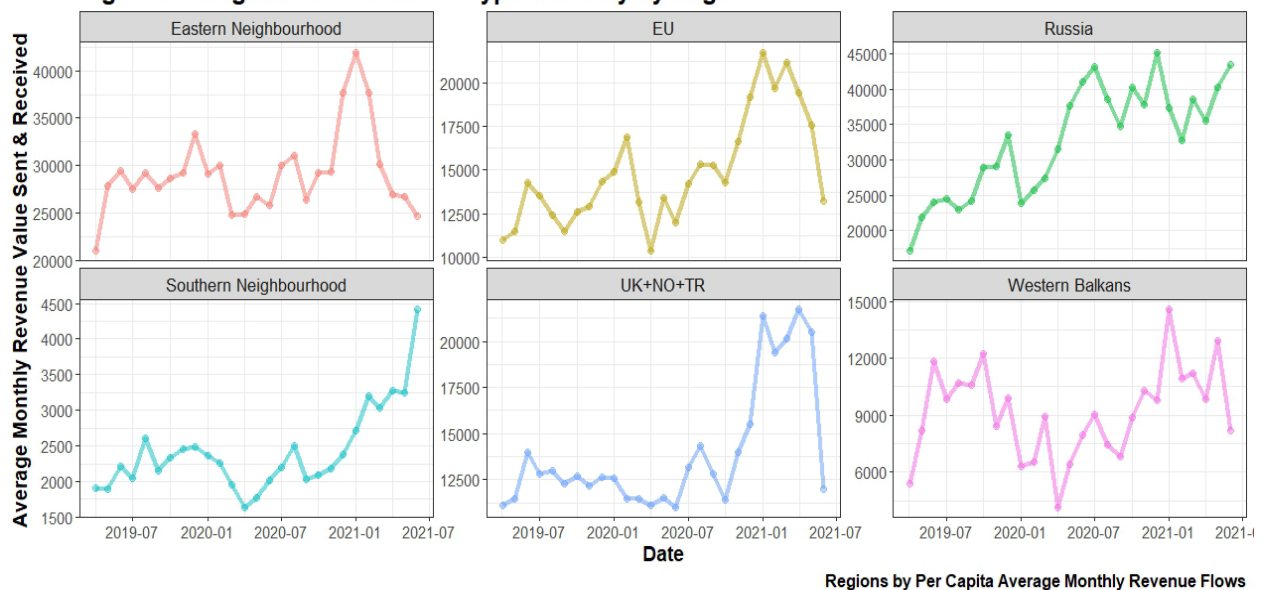


Figure 6. Longitudinal Trends in Cryptocurrency by Region



First, in absolute revenue terms, Russia transacted significantly more monthly DNM revenue on average than any other region (see also Subsection 3.3). Second, every region except the Western

Balkans has increased its absolute and per capita revenue engagement with darknet markets. Third, in per capita terms, several regions were roughly comparable in terms of economic engagement with darknet markets, with Russia being similar in this regard to the Eastern Neighbourhood, and the UK, NO, TK region being similar to the EU. Finally, engagement with DNMs in the Western Balkans remained comparatively low and exhibited a flat trend over this period, in absolute and per capita terms. The EU's Southern Neighbourhood had very low absolute and per capita revenue engagement with darknet markets (see also Subsection 3.3). This suggests that DNM activity in this area is nascent. However, engagement increased significantly in the later part of the observation period based on the underlying directional trend.

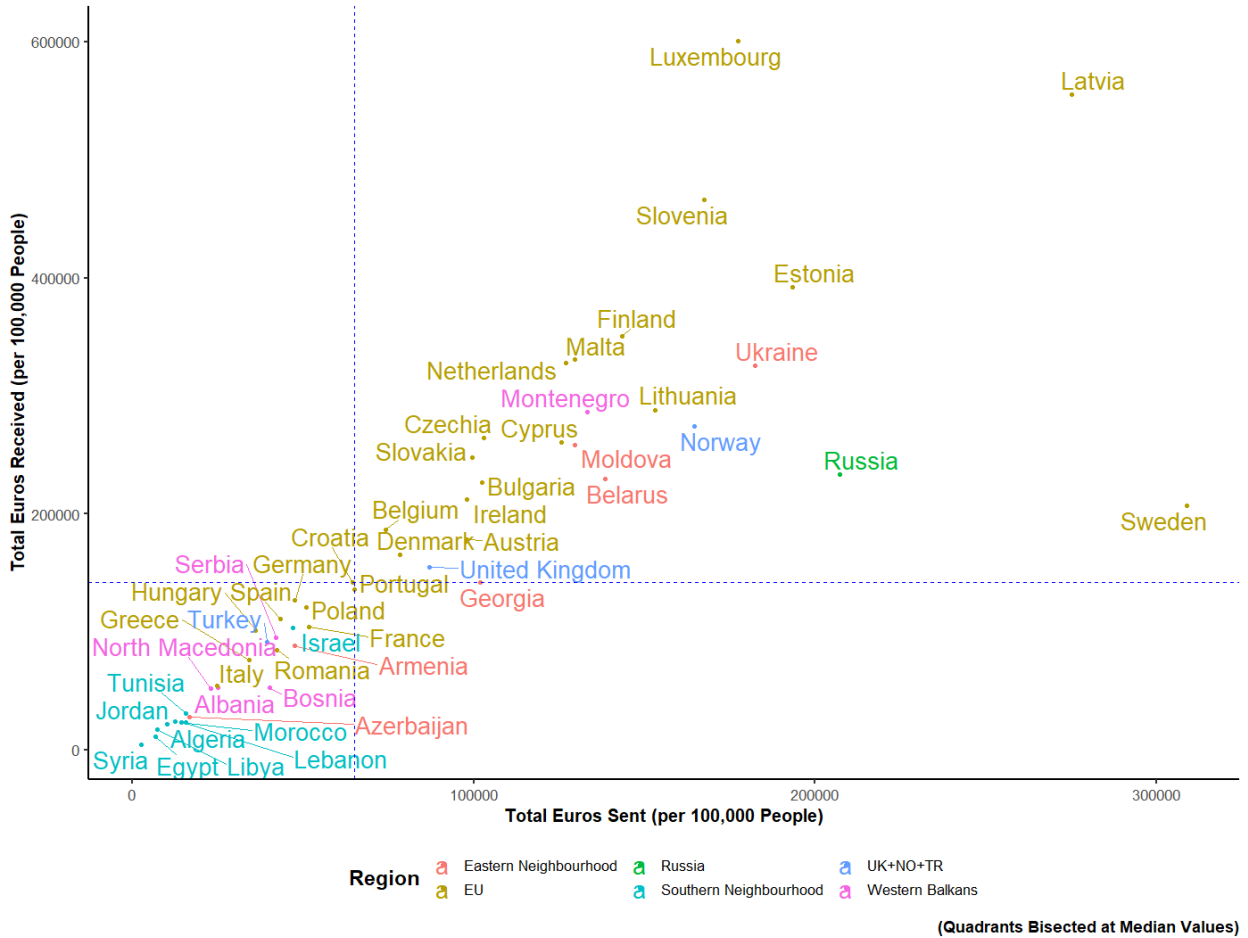
3.5. Countries within regions: A first look at per capita sent and received activity

Thus far, the regional analysis has aggregated countries into their overarching larger geographical units. This subsection presents a first look at distinct countries in a comparative perspective by plotting per capita sent and received revenues by country and region.

Figure 7 depicts aggregate summary values for the per capita rate of sent and received revenue by country and region for the entire available time range of the data. DNM transactions and revenue patterns tend to be distributed non-normally (Christin, 2013), which makes the average a poor measure of central tendency. Consequently, the chart is bisected into four quadrants at the median values of sent or received. The lower left quadrant next to origin can be thought of as the zone of countries that use cryptocurrencies to interact with DNM wallets the least, both as prospective buyers (sent) and potential vendors or administrators (received). Countries in the top left quadrant have a high received rate and would potentially be areas of comparatively large vendor or administrator activity. Countries in the lower right quadrant have comparatively high volumes of sent cryptocurrency and could be areas with large buyer populations. Countries that are in the top right quadrant have high volumes of both sent and received and could be thought of as major overall DNM players.

A few patterns are clear from the plot of the data. First, the countries in the EU's Southern Neighbourhood are not significant locations for DNM activity in per capita terms. No country from this region falls above the median value for either sent or received cryptocurrency. Second, only one country from the Western Balkans, Montenegro, could be categorised as a significant location for DNM activity (top right quadrant). Third, half of the countries in the EU's Eastern Neighbourhood are major areas of DNM activity, with the exception of Armenia, Azerbaijan and potentially Georgia (which sits on the median line). Finally, 19 of the 27 EU countries tend to receive and send a relatively large amount of cryptocurrency vis-à-vis DNMs in per capita terms (see also Subsection 3.3).

Figure 7 - Total Per Capita Sent/Received



Three countries within the EU also stand out as remarkable. Luxembourg has a very high receiving rate in per capita terms. Receiving funds suggests that DNM wallets are sending cryptocurrencies to this geography. Luxembourg might stand out in this regard due to some combination of its small population size (~640 000), which might give rise to issues of small-n variation, and the potential clustering of vendor or market admin wallets within the jurisdiction that could be receiving payments from DNM wallet addresses. In contrast, Sweden has a very high sending rate, which could imply that there are, on a per capita basis, a large number of buyers in the country who send revenue to DNMs. The fairly sizable market volume of Flugsvamp Market 3.0 could account for a portion of this clustering. Finally, Latvia is the largest overall per capita sender and receiver of DNM revenues, even if it has slightly lower values than Luxembourg for received euro and slightly lower values than Sweden for sent euro. The observable variation by country in Figure 7 suggests a need to explore country-specific trends more discretely (see Section 4).

4. Trends in DNM activity by country

4.1. Summary

- Within each region, countries exhibit a top-heavy pattern with notable gaps between the most engaged and least engaged country (except Russia, which is a single-country grouping).
- The regions can be divided into economically engaged mature (EU, Eastern Neighbourhood, UK+NO+TR and Russia) and immature (Southern Neighbourhood and the Western Balkans) areas, with notable differences in the relationship between the most active countries within each subset.
- The countries with the highest level of total per capita revenue engagement with DNMs in most regions exhibit little additional growth in activity. This suggests the potential for market saturation or regression to the mean dynamics.
- Countries that have regulatory bans on cryptocurrency (particularly those in the EU's Southern Neighbourhood) nevertheless see growing DNM revenue engagement.

4.2. Introduction

The previous section detailed various trends in DNM activity by regional grouping, with some limited disaggregation by country (see Subsection 3.5). This section further examines the country-specific trends. Each country has its own pattern of engagement with DNMs, as detailed below. We start with the EU, and then proceed through the UK+NO+TR regional grouping, the EU's Southern Neighbourhood, the EU's Eastern Neighbourhood, the Western Balkans and finally Russia.

4.3. The European Union

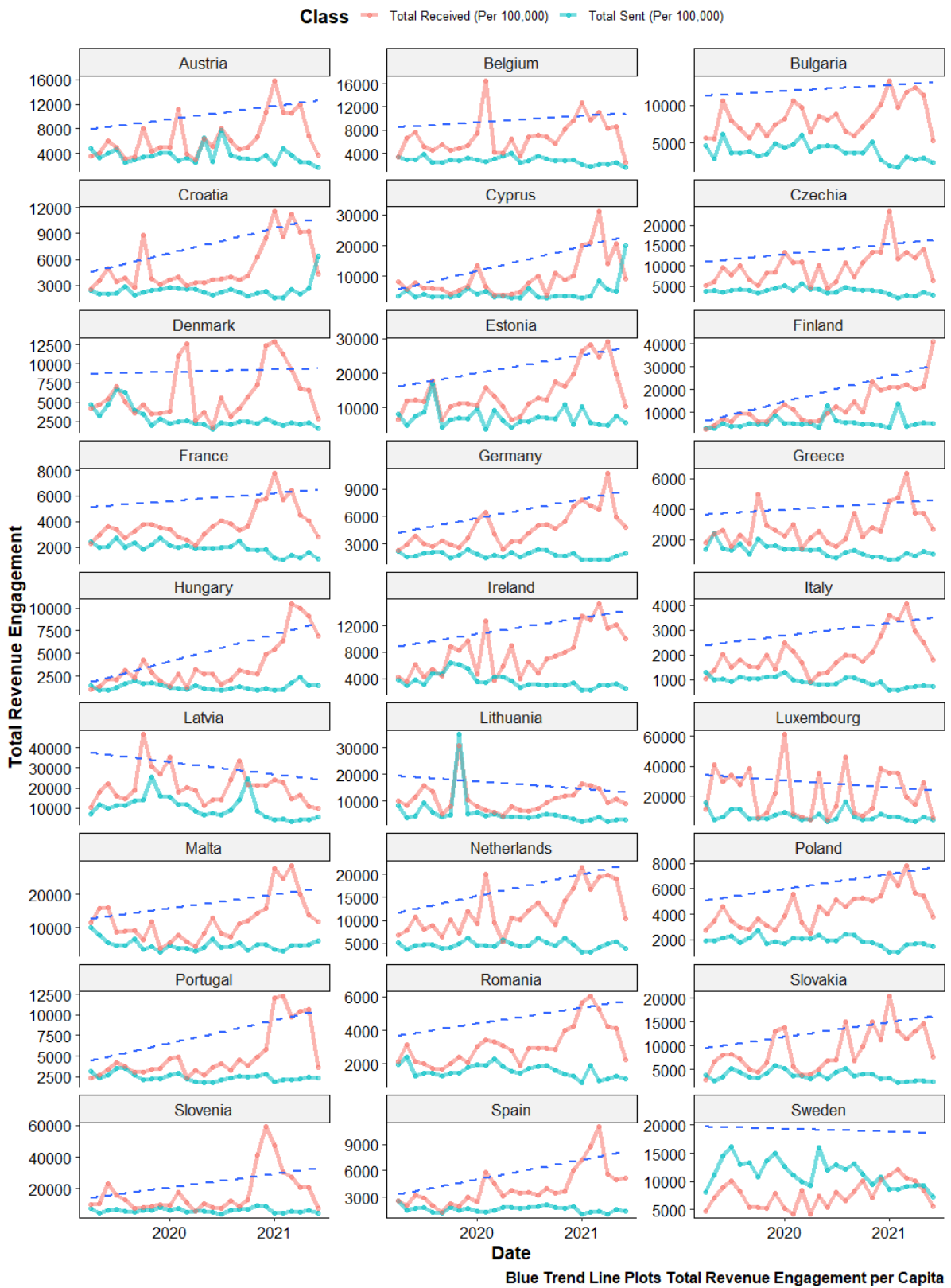
The EU includes large and small markets for DNM activities. Table 3 (see Annex) presents basic summary statistics for each country in this area. These statistics are expressed in per capita terms, since larger populations would likely lead to more activity of any type. To facilitate the conversion of the per capita (per 100 000 people) rates back into absolute values, we provide each country's average population level during the 2019-2020 period as recorded by the World Bank. All values in the table are in thousands and are rounded to two decimal places. The rank column organises the countries in the table based on their total per capita revenue engagement with DNMs.

Consistent with the plot of countries by region in Figure 7 (see Subsection 3.5), Latvia tops the list as the most engaged country within the EU. It sent and received the largest per capita amount of revenue vis-à-vis DNMs. Luxembourg was the second highest ranked country, which is also consistent with its high rate of received revenue from DNMs, as outlined in Figure 7. Interestingly, Sweden, which is an outlier on sent revenues, was ranked fifth overall. Slovenia and Estonia had higher total per capita revenue engagement during this period. In contrast, Italy had the overall lowest level. It sent and received just EUR 79 100 per capita (per 100 000) during this period or roughly 10.5 times less than Latvia's EUR 830 310 per capita rate.

The cross-sectional values presented in Table 3 show the total activity levels between 1 April 2019 and 1 June 2021, but do not capture the longitudinal trajectory in DNM activity for each country. Figure 8 plots these values for each country in the EU. The figure shows the trend in sent and received revenue and an overlaid directional trendline, which denotes the summed revenue activity for each country (the dashed blue line). The plot suggests that 23 of the 27 countries in this regional grouping engaged with DNMs at higher revenue rates over time. Interestingly, a few countries actually exhibited less total per capita revenue engagement with DNMs during the course of the study period. Luxembourg and Latvia are the most notable of the countries that had declining revenue engagement, as they were the top two countries in terms of total per capita DNM revenue engagement during the

full period (see Table 3). Potentially, country-level use of DNM might be subject to some degree of saturation and regression to the mean (see also Subsections 4.4 to 4.8 for more on this tendency).

Figure 8. Longitudinal Trends in DNM Revenue Engagement by EU Country

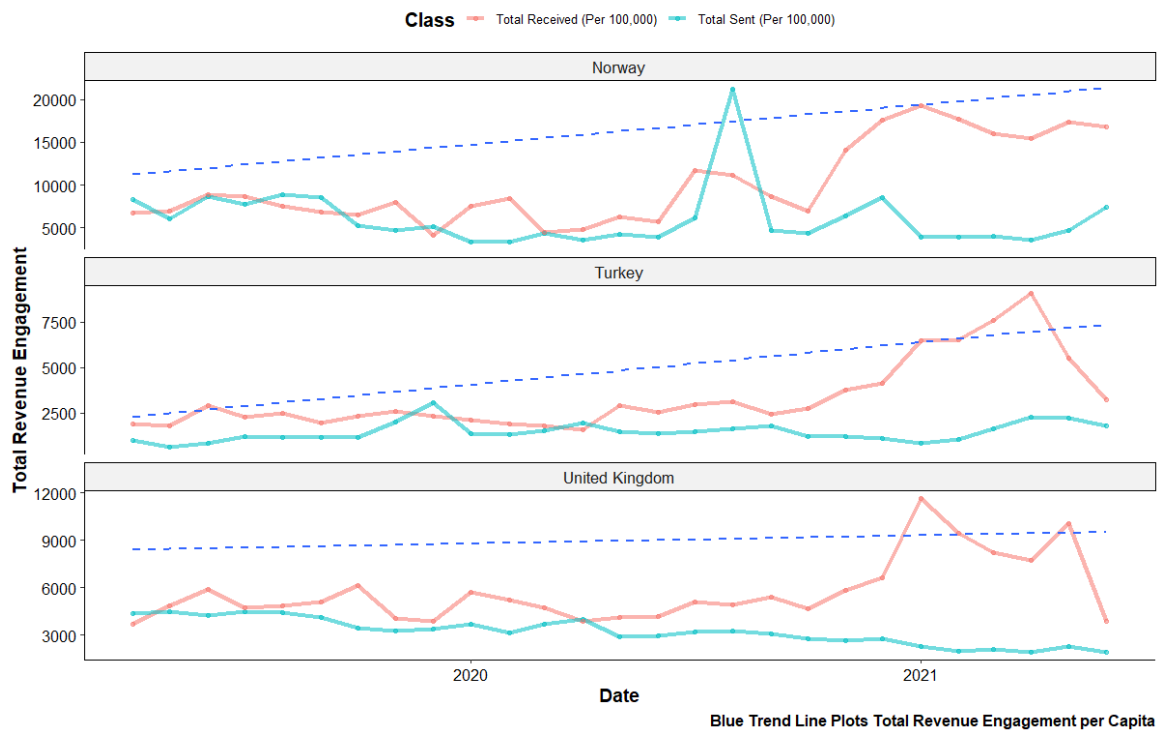


4.4. The UK+NO+TR regional grouping

The regional grouping of the United Kingdom, Norway and Turkey (UK+NO+TR) shows an inverse relationship between population size (Turkey to Norway) and per capita DNM revenue engagement (Norway to Turkey), as shown in Table 4 (see Annex). However, put into the context of the European Union countries (see Table 3), Norway would have a level of per capita revenue engagement that falls between the 9th (Lithuania) and 10th (Cyprus) most engaged countries in the region.

These period aggregates cannot reveal the direction of the trend in engagement with DNMs over time for these three countries. Figure 9 shows the longitudinal trend in sent, received and total DNM revenue engagement. Both Norway and Turkey exhibited an increasing rate of engagement with these markets, while revenue flows to and from the United Kingdom were essentially flat. Interestingly, Turkey's ban of BTC as a payment method in April 2021 coincided with a fairly pronounced reduction in the rate at which DNMs received cryptocurrency from this country. This means that DNM engagement by potential buyers from Turkey likely declined. However, the rate at which DNMs sent cryptocurrency to wallets within Turkey does not seem to have been affected in any meaningful way by the ban in the two months of additional data that are currently available.

Figure 9. Longitudinal Trends in DNM Revenue Engagement in the UK, NO, and TR



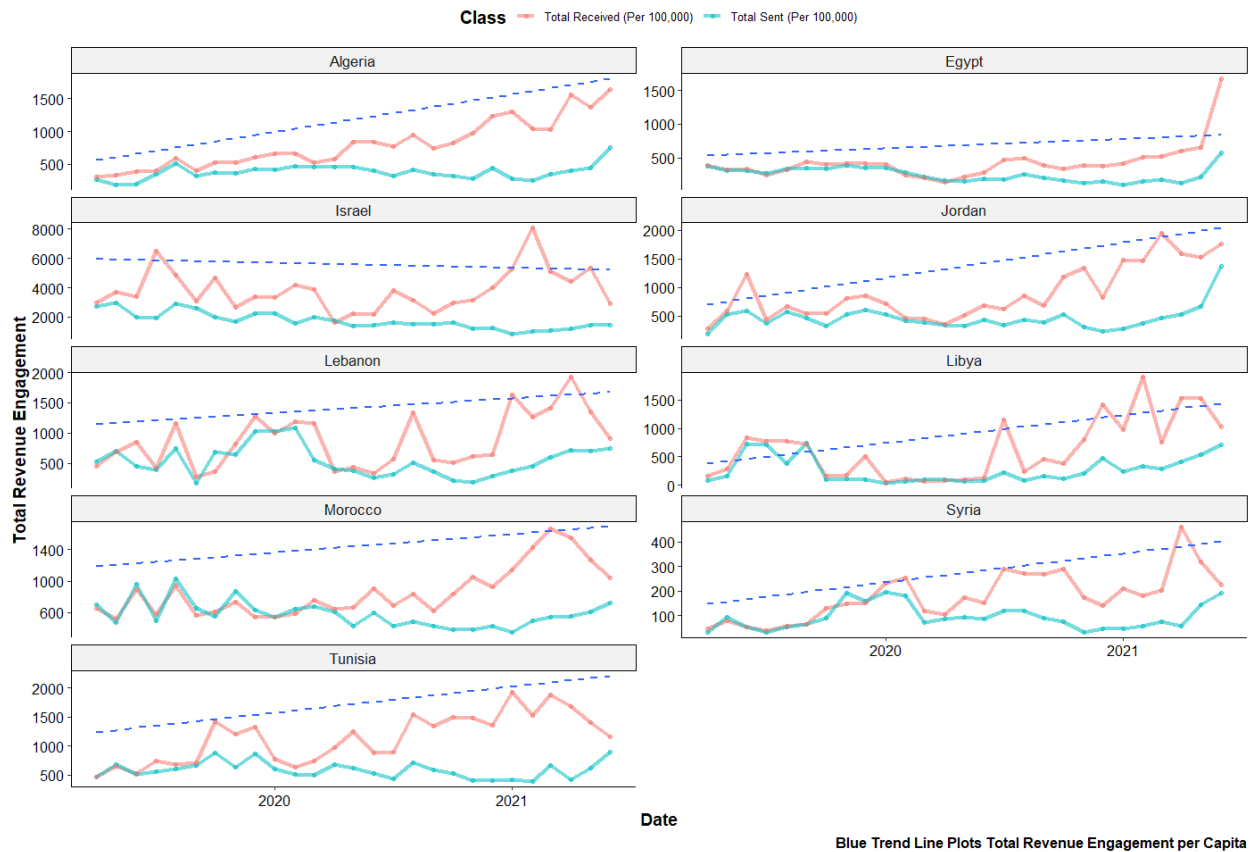
4.5. The EU's Southern Neighbourhood

Table 5 (see Annex) shows basic descriptive parameters for sent and received DNM revenue by country within the EU's Southern Neighbourhood. Within this region, Israel topped the list of total revenue engagement, with EUR 103 320 per 100 000 people sent and EUR 47 050 received. Syria was the least engaged country within the region, transacting a total of 20 times less total revenue than Israel. Interestingly, unlike in the EU grouping (see Subsection 4.3), the gap between the top country in the EU's Southern Neighbourhood and the next most active country was quite significant and amounted to almost a threefold difference (see Subsection 4.6 for another instance of this pattern).

Figure 10 shows the trend over time in sent, received and total per capita revenue engagement by all the countries in this region (note: Palestine is not included in this graph as World Bank population data are unavailable). Interestingly, all countries except Israel and perhaps Egypt showed fairly concerted

growth in DNM revenue engagement during this time. Israel's flat rate of DNM revenue engagement might suggest a saturation of DNM users in the country. It is telling that all the countries in the region except for Tunisia and Israel have banned cryptocurrency use within their respective jurisdictions, yet the trend in DNM revenue engagement remained positive in all these locations. While the data points are few, the results suggest that cryptocurrency bans are not particularly effective at preventing the use of these monetary instruments on DNMs within this region (see Section 5 on the legal context).

Figure 10. Longitudinal Trends in DNM Revenue Engagement by Southern Neighbourhood Country



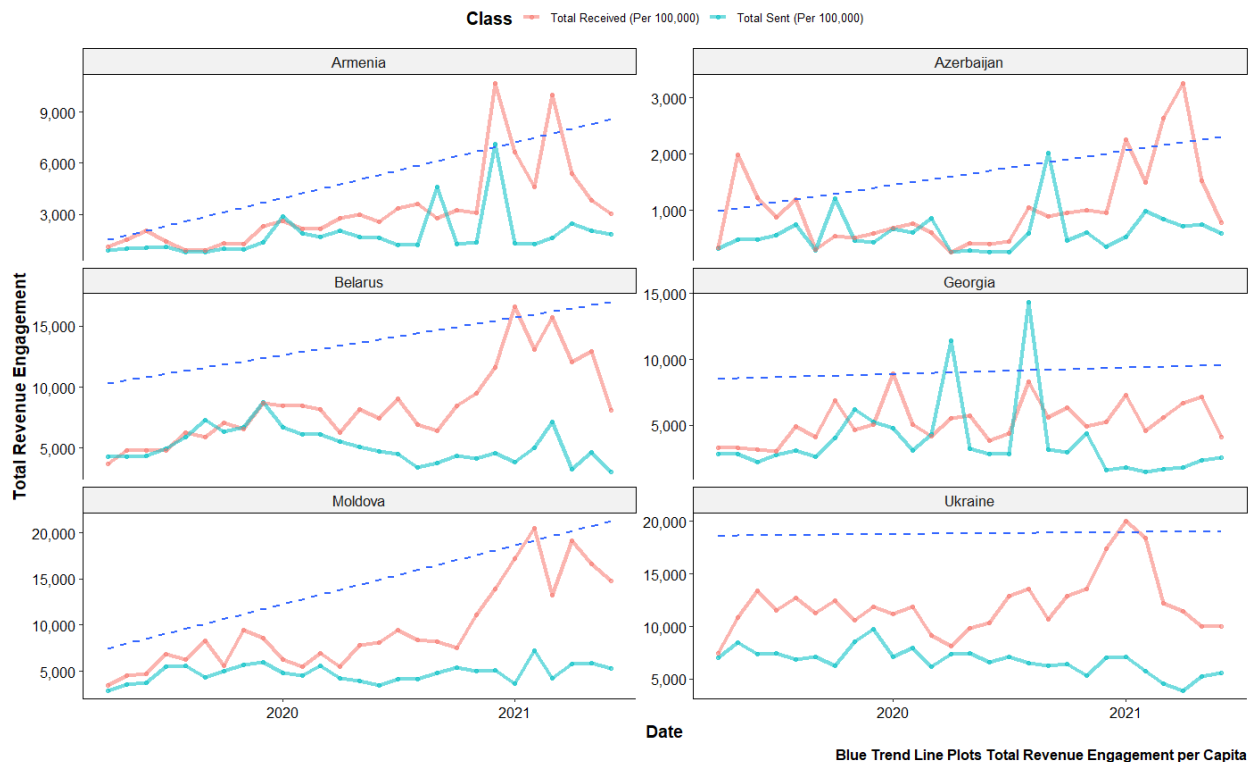
4.6. The EU's Eastern Neighbourhood

Table 6 (see Annex) details the revenue engagement pattern for countries within the EU's Eastern Neighbourhood. On a per capita basis, Ukraine had the highest total revenue engagement of all seven countries in this grouping, with EUR 508 120 per capita in cumulative sent and received. However, Moldova was only marginally behind Ukraine's total engagement rate. Consequently, the gap between first and second place was far narrower than that observed in the Southern Neighbourhood (see Subsection 4.5). Nevertheless, the gap between the top and bottom ranked countries in this region remained significant, with an 11-fold difference between Azerbaijan and Ukraine in terms of total per capita revenue engagement with DNMs.

Figure 11 plots the trend in each country's revenue engagement with DNMs. Four of the six countries in this region, Armenia, Azerbaijan, Belarus and Moldova, exhibited an increase in DNM revenue engagement over time. Interestingly, Ukraine, which had the highest total revenue engagement over the full period, did not show a great increase during the monitoring period. The flat trend on the otherwise highest ranked country is consistent with what was observed with Israel in the EU's Southern Neighbourhood (see Subsection 4.5) and is also broadly consistent with the flat or negative trend in the top countries within the EU (see Subsection 4.3) and the Western Balkans (see Subsection 4.7). Once again, this pattern suggests that at within-region peak levels of DNM revenue

engagement, some combination of regression to the mean and market saturation may dampen additional uptake and use.

Figure 11. Longitudinal Trends in DNM Revenue Engagement by Country in the EU's Eastern Neighbourhood



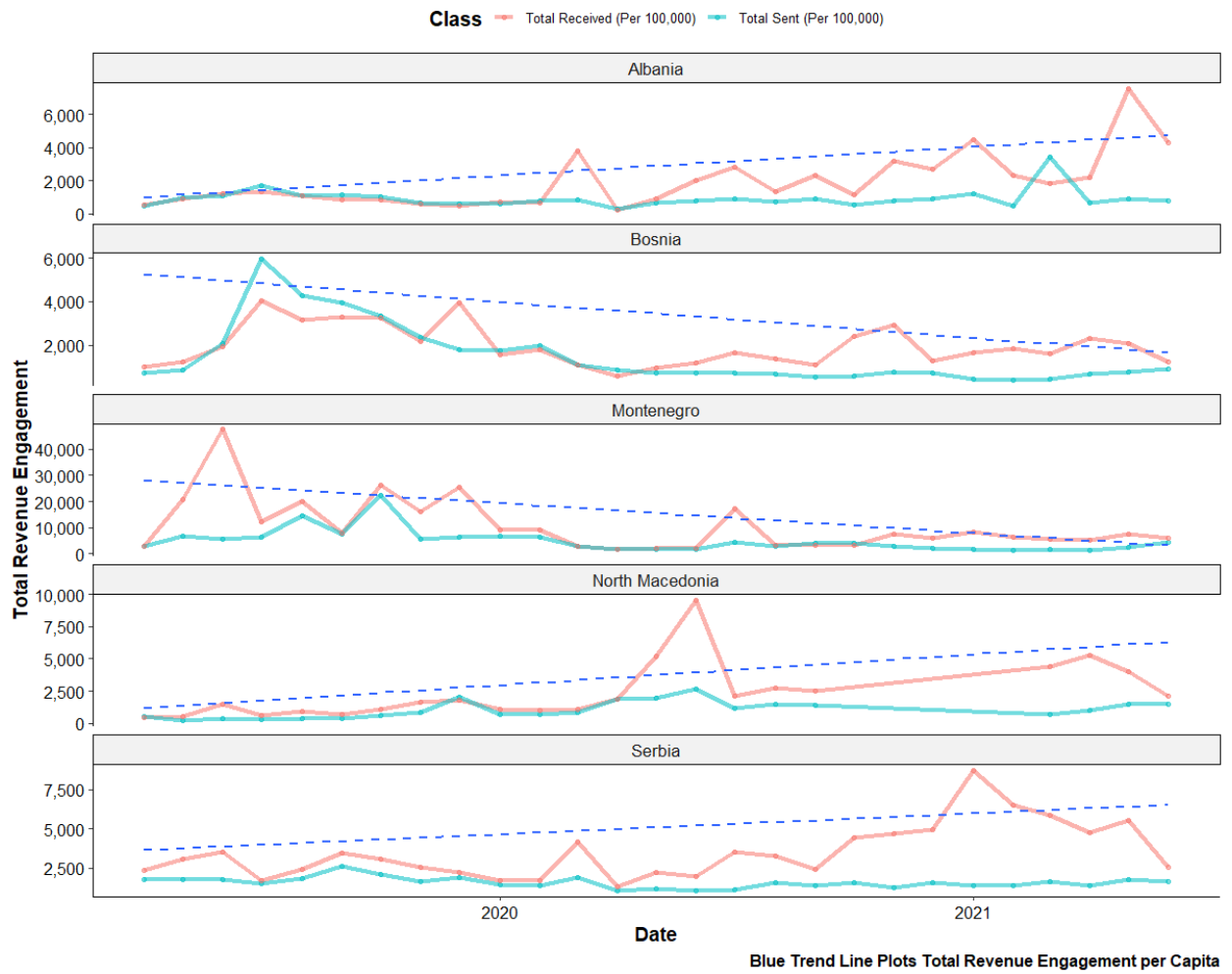
4.7. The Western Balkans

Countries in the Western Balkans exhibited the same top-heavy pattern seen in the EU's Southern Neighbourhood (see Subsection 4.5). In terms of total per capita DNM revenue engagement, the gap between Montenegro (EUR 419 710) and the second most engaged country in the region, Serbia (EUR 137 050), was sizable. Whereas the gap between the top two countries by total per capita revenue engagement was only ~1.1-fold in the EU and ~1.3-fold in the EU's Eastern Neighbourhood, the wide gap between the top two locations in the Western Balkans was 3.06-fold (with a 3.2-fold gap in the EU's Southern Neighbourhood). The gap between the most and least active countries in the Western Balkans was a factor of 5.5, putting it at the lower end of the top-to-bottom multiples among all regions (see Table 7 in the Annex).

These comparisons suggest that there are likely two types of regions. First, there are those that ought to be considered mature markets, with large top-to-bottom ratios but small top-country differences (the EU, the UK+NO+TR area, the EU's Eastern Neighbourhood and Russia; see Subsection 4.8). Second, there are immature DNM areas, where the gap between the most and least active countries may remain sizable, and the gap between the two top countries in the region is also quite large (the EU's Southern Neighbourhood and the Western Balkans).

Figure 12 plots the temporal trends in DNM revenue engagement for the five countries in the Western Balkans for which there are data (Kosovo is excluded due to a lack of cryptocurrency data). In three of the five (Albania, North Macedonia and Serbia), the degree of revenue engagement increased during the study period. Interestingly, as seen in the EU (see Subsection 4.3), the top country in the region in terms of total per capita revenue engagement (Montenegro) showed a slight declining trend in DNM participation. Once again, user-base saturation and regression to the mean might be at play.

Figure 12. Longitudinal Trends in DNM Revenue Engagement by Country in the Western Balkans



4.8. Russia

As is clear from Figure 13, Russia saw a clear increase in revenue engagement with DNMs over the study period. While its absolute value of revenue engagement was very high, its per capita engagement (see Table 8 in the Annex) shows that the total per capita participation in the DNM ecosystem for Russia was roughly comparable to that of Lithuania, which was the ninth most engaged EU country. While the Hydra Marketplace dominated the DNM ecosystem, Russian engagement was at least partly a function of population size.

Figure 13. Longitudinal Trends in DNM Revenue Engagement in Russia



4.9. Hydra Marketplace

On 5 April 2022, the Hydra Marketplace was closed by a joint law enforcement effort involving multiple US and German agencies. As the earlier part of this report illustrates (see Section 2.2), the Hydra Marketplace was the primary site in the DNM ecosystem in recent years. Its removal will undoubtedly disrupt the use of DNMs, but past closures of this sort suggest that the effects will likely be short-lived (Décary-Hétu and Giommoni, 2017; Van Buskirk et al., 2017; Van Buskirk et al., 2014). While Hydra was a market of primary importance from 2020 to early 2022, the same could have been said for Silk Road in 2011 to 2013 or AlphaBay in 2017 at the time of their closures. In each case, activity within the DNM ecosystem recovered rapidly following the event, as users migrated to other sites (ElBahrawy et al., 2020; van Wegberg and Verburgh, 2018). Figure 1 illustrates these drops and the recovery of activity.

Other markets in the ecosystem could readily absorb former Hydra Marketplace users after its closure. According to Chainalysis data, 67 markets were waiting in the wings during 2021, including Flugsvamp Market 3.0, Iceteam, World Market and ASAP Market. One or more of these will probably capture much of the revenue and transaction activity that was formerly held by Hydra. The recovery might take time, and some users might move to peer-to-peer exchanges (see Figure 15 in Section 6), but there is nothing to suggest that this time will be different. Continued monitoring will be key.

5. Legal frameworks

5.1. Summary

- Cryptocurrency exchanges are a common way of initially obtaining cryptocurrency to capitalise on-chain wallets.
- Exchanges governed by know-your-customer (KYC) and anti-money laundering (AML) rules are typically required to obtain real identity documents from their clients, allowing law enforcement to trace transactions from DNMs to real-world individuals.
- Not all countries in the sample have KYC and AML rules in place for exchanges working within their jurisdictional boundaries.
- Some country rules are inconsistent in design or application, which raises the prospect of regulatory arbitrage.
- Ten of the 54 countries in the sample (~15 %) have outright bans on the use of cryptocurrencies, yet engagement with DNM continues in these locations.

5.2. Introduction

The legal regimes governing cryptocurrencies are complex, multifaceted and rapidly evolving. For example, Russia was heading toward a ban on cryptocurrency in early 2022, only to reverse course and recognise Bitcoin and other cryptocurrencies. The implications of this variability are twofold. First, the details reported in this final section must necessarily be read as contextually and temporally dependent. The legal regimes that are in place are likely to change over time. The second implication is that each country, with its unique overarching set of regulatory rules governing cryptocurrency and the financial system more generally, would be worthy of its own report. As a result, this section necessarily provides a high-level summary of the broad features of the current legal regimes across all 54 countries in the sample (see Subsection 5.2) and then a few select country case studies (see Subsection 5.3). This treatment is not, nor does it aim to be, comprehensive.

5.3. The broad contours of legal rules across 54 countries

The broadest contours of cryptocurrency regulation revolve around three main axes: bans, know your customer (KYC) and anti-money laundering (AML). Table 9 (see the Annex) provides a glimpse of these three dimensions across all 54 countries discussed in this report. These categorisations are telling. Only 10 of the 54 countries in the sample (~16 %) had outright bans in February 2022. Interestingly, these areas are heavily clustered in the EU's Southern Neighbourhood (e.g. Algeria, Egypt, Jordan, Libya, Lebanon, Morocco and Palestine), with Turkey, North Macedonia and Kosovo (which bans mining) being the other three.

While outright bans on cryptocurrency are comparatively rare in the countries in the sample, more permissive environments are common. Eighteen countries (33 %) do not impose clear KYC rules on cryptocurrency exchanges and 17 countries (34 %) do not use complementary (and overlapping) AML regulations. Spain is the one outlier that does not use KYC but does use AML rules to govern cryptocurrency exchange operations.

KYC and AML rules can potentially have material implications for how people engage with DNMs and the effectiveness of law enforcement. Wallet interactions internal to the blockchain are observable. Wallet A might interact with Wallet B that, in turn, interacts with Wallet C. All these transactions are recorded as entries in a block and become part of the permanent, transparent ledger of BTC on-chain activity. If Wallet B in this scenario is a known DNM wallet, then the identity behind Wallet A might be of interest to law enforcement, since this could be a buyer of drugs, and the identity behind Wallet C might likewise be of interest since it could be a drug vendor account.

Knowing the identity of the person or organisation behind either wallet could require tracing activity back to the initial point of wallet capitalisation. Exchanges are by far the simplest way to obtain cryptocurrencies to become a participant in the respective blockchain (once the tokens are moved off the exchange). Since due diligence rules require exchanges to conduct KYC and collect customers' identifying information, law enforcement can leverage this information when they identify illicit transactions on the blockchain. Exchanges act as entry and exit points that illicit actors must use to exchange fiat currency for cryptocurrency. When law enforcement traces an illicit transaction from a DNM to an exchange, they can serve a legal process to the exchange and request information about that transaction. They can ask for identifying information about a user behind a wallet address of interest. This allows them to obtain information gathered by the exchange during the KYC process when exchanges are subject to AML frameworks and regulation.

5.4. Regional and country examples

This subsection presents several short case studies of the legal context that prevails in many of the countries detailed in quantitative terms above. The information for these case studies comes from the expertise of the policy team at Chainalysis, with additional contributions by the European Commission, EMCDDA, Reitox network and other experts from the EU Member States, national correspondents in the Western Balkans and other partners.

The European Union

The Fifth Anti-Money Laundering Directive ⁽⁴⁾ (5AMLD), which was adopted in May 2018 and came into force on 10 January 2020, introduced a definition of virtual currencies and recognised providers engaged in exchange services between virtual currencies and fiat currencies, as well as custodian wallet providers, among the entities subject to anti-money laundering and countering terrorism financing requirements. This means they must adhere to a number of AML/CFT controls, such as KYC obligations, transaction monitoring, registration requirements, suspicious transaction reporting and record keeping requirements in the European Union.

Since 5AMLD is a directive rather than a law, EU Member States must individually implement its provisions. This means that there have been variations in the extent of its implementation. Due in part to the variation in regulations among Member States, in July 2021, the European Commission published a new anti-money laundering legislative package entailing 4 text proposals with new provisions on crypto-assets. The proposal to amend the Regulation on transfers of funds provides for an obligation for all crypto service providers involved in crypto transfers to collect data on the originators and beneficiaries of the crypto-assets transfers they operate and keep them available for the competent authorities in charge of the fight against money laundering and terrorism financing. It is also making some modifications to the current AMLD to introduce among obliged entities all the crypto-assets services providers (CASPs) recognised under the Markets in Cryptocurrency Assets Regulation (MiCA) proposal ⁽⁵⁾. The aim of this legislation is to avoid legal fragmentation and jurisdictional arbitrage in the EU by adopting a comprehensive package of legislative proposals for the regulation of cryptocurrency assets. It is expected that this legislation, which is currently under review,

(4) Directive (EU) 2018/843 of the European Parliament and of the Council of 30 May 2018 amending Directive (EU) 2015/849 on the prevention of the use of the financial system for the purposes of money laundering or terrorist financing, and amending Directives 2009/138/EC and 2013/36/EU (OJ L 156, 19.6.2018, p. 43).

(5) CASPs under MiCA regulation include businesses that, on behalf of others, exchange crypto assets for other crypto assets or for fiat currencies, transfer crypto assets, provide safekeeping or administration of crypto assets or instruments that enable control over crypto assets, and participate in or provide financial services related to the offer or sale of crypto assets. This category generally encompasses crypto asset exchanges, crypto ATMs or kiosks, peer-to-peer exchanges, over-the-counter (OTC) desks and custody providers. The Financial Action Task Force (FATF) uses the term 'virtual asset service provider' or VASP rather than CASP. However, as the European Union typically refers to this asset class as 'crypto assets' we use CASP here.

will solve many of the implementation challenges that individual Member States have faced and put forward a unified approach to regulated cryptocurrency assets.

Germany

Germany has not implemented legislation specific to crypto assets, but instead brought them under their general financial regulatory regime. This means various types of distributed ledger technology (DLT) tokens are within the scope of capital markets, banking, financial services, anti-money laundering and other laws.

The German Banking Act, Kreditwesengesetz or KWG, expanded the definition of financial instruments to include crypto assets. Crypto custodians and exchanges offer financial services. This means that they are subject to the same AML/CFT obligations as other obliged financial institutions. In addition to crypto custodians and exchanges, these provisions apply to over-the-counter (OTC) brokers and insurance providers.

In line with various EU laws, the KWG outlines the general regulatory regime for banking and financial services in Germany. It sets out strict licensing requirements, minimum capital requirements, management requirements (e.g. fit-and-proper tests), risk management rules, AML and KYC principles, supervision requirements and a detailed framework on various other issues. Businesses that provide services related to crypto assets such as the custody and exchange of tokens and engage in the maintenance of tokenised securities registries must obtain a BaFin license.

Germany was one of the first countries in Europe to mandate the Travel Rule (Financial Action Task Force [FATF] Recommendation 16), which requires CASPs to ensure that certain customer data are disclosed and transferred between counterparties as part of the transaction. Germany implemented this requirement before the EU at large, with the obligation coming into force in October 2021 and requiring that CASPs ensure Travel Rule compliance within 12 months. CASPs may request that their obligations are suspended due to missing technical possibilities to transfer data (one-time re-suspension possible).

Malta

Most European countries brought cryptocurrency assets under their AML laws in 2020 with the implementation of 5AMLD. However, Malta was an early adopter and introduced landmark legislation in 2018 that defined a new regulatory framework for cryptocurrencies. This regulation brings CASPs under the scope of AML/CFT laws.

The Virtual Financial Assets Act (VFA Act) applies to cryptocurrency exchanges, initial coin offerings (ICOs), brokers, wallet providers, advisers and asset managers. It outlines a regulatory regime, including licensing and registration requirements, AML/CFT obligations, requirements for initial VFA offerings and trading on DLT exchanges and record-keeping requirements, among other things.

In 2021, MONEYVAL, the Council of Europe's AML/CFT monitoring and evaluation body entrusted with assessing compliance with international AML/CFT standards and the effectiveness of their implementation, revised their assessment of Malta. Previously, Malta has been deemed 'partially compliant' in relation to FATF Recommendation 15, which deals with new technologies, including cryptocurrency assets. In this 2021 assessment, their rating improved to 'largely compliant', meaning that Malta's regulatory regime for cryptocurrency assets and CASPs addresses most FATF recommendations with only minor shortcomings.

Estonia

Estonia was one of the first countries to move into the cryptocurrency regulatory space. As early as 2017, virtual asset service providers (VASPs) were considered obliged entities under the Estonian AML law and the country started issuing cryptocurrency licenses for exchanges and custody

providers. Before the license obligation the VASPs were seen as providers of service of alternative means of payment, who only had a registration obligation. Estonian regulation of cryptocurrency businesses has been gradually developing, and some cryptocurrency businesses not based in Estonia took advantage of their ability to register there in the earlier years. In March 2020, the AML/CFT legislation was amended and merged licenses, such as providing services of exchanging a virtual currency against a fiat currency and providing a virtual currency wallet service, into one license providing a virtual currency service. This amendment also required entities licensed in Estonia to have their head office physically located within the country, regardless of where their customers might be.

In 2022, Estonia introduced further regulations for cryptocurrency services. All current license holders are required to apply for a new license. In addition to higher minimum share capital, regular reporting, auditing obligations and limited legal forms for operating, the regulation goes beyond the current 5AMLD. The new regulation brings crypto-to-cryptocurrency service providers under the scope of the regulation.

Romania

Law no. 129/2019 to prevent and combat money laundering and terrorism financing, with subsequent amendments and additions, establishes that the providers of exchange services between virtual currencies and fiduciary currencies and providers of digital wallets (VASPs) are reporting entities. Therefore, they are obliged to comply with the legislation in the field of combating money laundering and terrorist financing, including the mandatory requirement to be authorized or registered by the Ministry of Finance, through the Foreign Exchange Offices Authorization Commission. A draft Government Decision is currently underway, regarding the approval of the procedures for authorization and registration of providers of exchange services between virtual currencies and fiduciary currencies and providers of digital wallets, which is in an advanced phase of endorsement.

In view of the above situation, at the initiative of the National Office for Prevention and Control of Money Laundering – FIU Romania, The Government of Romania has adopted the appropriate legal framework that requires providers of exchange services between virtual and fiat currencies and providers of digital wallets to notify FIU Romania, exclusively electronically, of the commencement, suspension or termination of the activity falling under the AML/CFT law, within 15 days from the date of commencement, suspension or termination of such activity.

Pursuant to these legal provisions, by 25.10.2022, a total of 28 VASPs have notified FIU Romania.

Sweden

The Swedish Currency Exchange Act requires that custodian wallet providers and cryptocurrency exchanges (VASPs) comply with registration and Swedish Anti-Money Laundering Act (AML act) requirements. VASPs must apply for registration with the Swedish Financial Supervisory Authority. To do business, they must be able to show that their operations will be conducted in an AML-compliant manner and VASP owners and senior management officials must pass an assessment.

The EU's Southern Neighbourhood

In most countries in the EU's Southern Neighbourhood, the use of cryptocurrencies is not allowed. However, this situation could change in the near future, as cryptocurrencies are perceived as an opportunity to create additional resources for taxation. In Lebanon, the financial crisis has led to a spike in cryptocurrency use, both as a means of recovering savings through speculative trading and as a way to circumvent a broken banking system. In Lebanon, the presence of activities related to mining and virtual asset service providers were noted. The Bank of Liban (BDL) and the Financial Markets Authority issued a ban for financial institutions to trade virtual assets and any operation related to them in order to prevent their use in money laundering and terrorist financing. The security forces are preparing units specialized in investigating virtual currencies. In Egypt, Bitcoin transactions

are classified as 'haram', prohibited under Islamic law. Israel and Tunisia do not ban the use of cryptocurrencies, while Algeria, Egypt, Jordan, Libya and Morocco either do not recognise cryptocurrency transactions or have categorised them as illegal. In Tunisia, the use of crypto currency is not prohibited by law, but transactions carried out with Bitcoin can be assimilated to money laundering, punishable by law.

The EU's Eastern Neighbourhood

Compared with the EU's Southern Neighbourhood, the countries in Eastern Europe have either adopted laws that regulate the usage of cryptocurrencies or they do not apply any restrictions. In December 2017, the Belarusian government adopted Decree No. 8 on the Development of Digital Economy. This marked the country's first formal law governing cryptocurrency and blockchain. The decree came into force on 28 March 2018. Subsequently, in November 2018, the Supervisory Council of the Hi-Tech Park approved additional guidance for token-related activities. In Armenia, Azerbaijan, Georgia and Moldova there are no regulations on cryptocurrencies.

In Ukraine, the law on virtual assets (March 2022) has endorsed cryptocurrencies. The new law enters into force with the law on amendments to the Tax Code on the peculiarities of taxation of virtual asset transactions. This law regulates legal aspects arising in connection with the income from virtual assets, defines the rights and obligations of participants in the virtual assets market and the principles of state policy in the area of virtual assets income.

Georgia is among one of the top cryptocurrency countries in the world. However, it does not have any legislative restrictions for cryptocurrency exchange. To date, it does not require any license for such activity. In addition, Georgia provides a high tax certainty and beneficial tax system for businesses involved in the cryptocurrency field. The World Bank estimated in 2018 that at least 200 000 people in Georgia are involved in cryptocurrency mining.

Western Balkans

In the Western Balkans, North Macedonia banned trading with cryptocurrencies (Chakraborty, 2021). Kosovo has recently taken legal measures through the Law on Energy to forbid cryptocurrency mining due to the energy-intensive nature of these activities, coupled with broader problems of power generation and supply (Bami, 2022); this ban applies until the emergency measures related to energy supply are in force. In Bosnia and Herzegovina, there is currently no regulation on the use of cryptocurrencies. However, the Central Bank has stated that only official currency can be used for payments (Vijesti, 2018). Cryptocurrency is not regulated in Montenegro (Veljović and Vučinić, 2022).

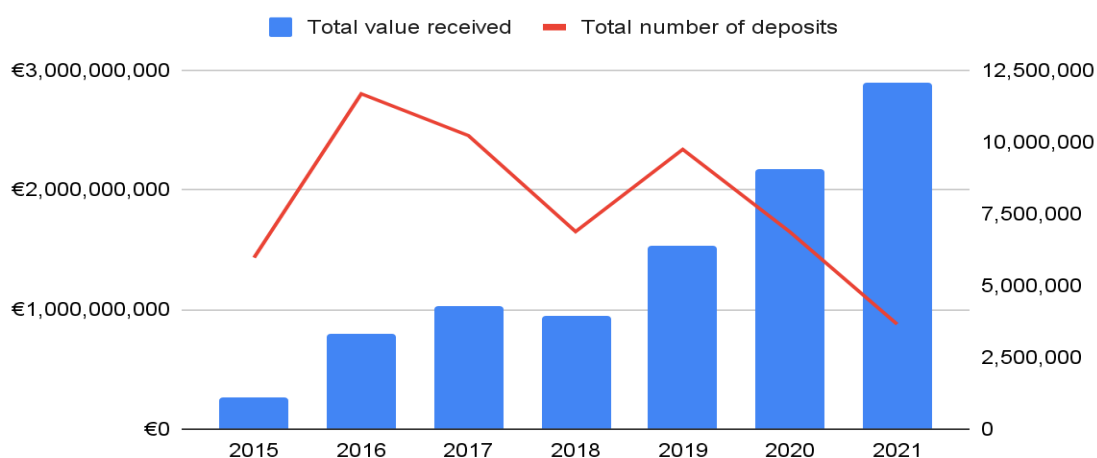
Albania regulates cryptocurrencies with the Law on Financial Markets based on Distributed Registry Technology. This stipulates, *inter alia*, the licensing of activities related to distributed ledgers technology and the trading or storage of tokens and virtual coins (Kalo&Associates, 2020). Similarly, Serbia has regulated cryptocurrency trading and mining through the Law on Digital Assets. This law came into force in December 2020 but its application has been postponed until June 2021 (Partners, 2022). According to this law, there are two types of digital assets, namely virtual currencies and digital tokens.

6. Policy implications

The data presented in this report depict a DNM ecosystem that is generally robust to market closures, scams and the other adverse events that happened between 2011 and 2021 (Décary-Héту and Giommoni, 2017; Jardine, 2021; Van Buskirk et al., 2017; Van Buskirk et al., 2014). The market ecosystem overall has continued to expand, albeit at a slower pace than in the early years. However, the geographical distribution of activity in the countries studied is variable and currently heavily clustered in the EU and Russia. The regulatory landscape surrounding cryptocurrency continues to evolve rapidly, but there is only a preliminary, tentative indication that cryptocurrency bans and more severe measures noticeably affect DNM engagement at country level.

The findings of this report suggest that several potential supply-side and demand-side drug policy efforts are needed. Policies focused on enabling DNM investigations are required to detect, deter and disrupt the operation of these markets. A thorough review of such policy recommendations is beyond the immediate scope of this paper, as each jurisdiction has a distinct context of DNM use and would need to develop similarly distinct drug-related policies. However, some basic trends are worth noting. First, on the demand side, DNM activity is persistent and continues to increase, although at a slower rate than in the early years of the ecosystem (see Subsection 2.2).

Total value received value and number of deposits by darknet marketplaces in EUR, annual



While demand for DNM services continues to increase, how users engage with the markets, and the participants within them, is also changing. Market closures can disrupt use of darknet markets in the short term. However, vendors and customers are highly adaptive and have begun to undertake more peer-to-peer exchanges that circumvent DNM wallets altogether. Such direct buyer-to-vendor sales – transactions that take place without going through a DNM – have been on the rise since 2019. It is suspected that many of these buyer-vendor relationships were initially established on darknet markets, but that after a series of successful purchases, the buyers and vendors then arranged to transact off-market. Sales of this kind reached USD 112 million during 2021, which is equivalent to approximately 5 % of total darknet market revenues.

This growth in direct sales volume might be explained by deepening trust between long-time buyers and vendors, growing distrust of darknet markets, a wish to avoid DNM fees, a desire to avoid being linked to known illicit activity or likely a combination of these factors. Policy options should take into consideration these demand dynamics that impact cryptocurrency darknet market activity.

In addition to focusing on understanding the demand side, law enforcement must have the training and resources they need to conduct DNM investigations. These investigations are different from

traditional drug investigations that law enforcement has been undertaking for decades. They require training on the technologies that are being employed and the new investigative techniques necessary for conducting these sorts of investigations.

To fully engage in effective policing of the DNM ecosystem, law enforcement officers and analysts will need training on how to identify the illicit use of cryptocurrency in a case; how to access Tor and operate safely online; how to employ encrypted communications platforms; the tactics, techniques and practices employed by illicit actors and how they are evolving; how to bring a case from start to finish; how documenting cryptocurrency-related investigations may differ from 'traditional' investigations; how to trace illicit cryptocurrency and how to seize it, taking into consideration that the chain of custody may work differently for cryptocurrency wallets than it does for other types of seized assets; and a myriad of other things.

Law enforcement will likely need access to new and different types of technology and tools than they have typically used in drug-related investigations, which will require time (to learn the tools) and finances (to acquire the tools). These tools will include undercover equipment, blockchain analysis and other cyber investigative tools. Law enforcement should leverage public-private partnerships and partnerships with other law enforcement agencies domestically and internationally. Public-private partnerships enable law enforcement to improve their data, to gain a better understanding of trends that will allow them to adjust and prioritise investigative strategies.

Partnerships with international law enforcement agencies are important in these sorts of investigations because crimes often span country borders due to the fact that they are internet-based. Partnerships with other agencies help to ensure deconfliction and avoid duplication of efforts. Task forces lend themselves well to DNM investigations, as many agencies will have data and information relevant to a case. An example of a successful task force in the United States is the Joint Criminal Opioid and Darknet Enforcement Team (JCODE). Established within the Federal Bureau of Investigation's Hi-Tech Organized Crime Unit, JCODE is a US government initiative to target drug trafficking, especially in fentanyl and other opioids, on the darknet. The JCODE team brings together agents, analysts and professional staff from many law enforcement agencies with expertise in drugs, gangs, healthcare fraud and more. The collaboration between US and Dutch law enforcement and Europol during Operation Bayonet in 2017 (which closed AlphaBay and Hansa) also demonstrates the importance and effectiveness of such partnerships.

Finally, it is critical that countries around the world implement the recommendations from the Financial Action Task Force's Guidance for a Risk-Based Approach to Virtual Assets and Virtual Asset Service Providers. These recommendations include requiring that virtual asset service providers (a category that includes cryptocurrency exchanges, cryptocurrency ATMs, over-the-counter brokers and peer-to-peer exchanges, among others) be registered or licensed and maintain effective AML programmes, including customer due diligence (KYC). Implementing such regulations would help to ensure that when law enforcement is investigating the illicit use of cryptocurrency – say, someone cashing out funds from a DNM and sending it to an exchange – they can obtain identifying information about users linked to the cryptocurrency flows to further investigations.

Glossary of terms

AML: anti-money laundering rules that govern many cryptocurrency exchanges and most traditional financial entities.

Bitcoin (BTC): a digital token that can be shared peer-to-peer as a form of payment.

Blockchain: a database that is stored and validated in a distributed way, in contrast to a centralised database maintained by a trusted third party.

CFT: combating the financing of terrorism rules that govern financial entities in many locations.

Cryptocurrency: the broader class of digital tokens that can be used for payments.

Darknet market (DNM): sites that are only accessible via the Tor browser and that combine the anonymity-granting functions of Tor with the pseudonymous payment methods of cryptocurrency, particularly Bitcoin.

Euro-to-transaction ratio: a ratio variable that divides monthly DNM revenue by the monthly DNM transaction count. Higher values suggest greater revenue per transaction per month.

KYC: know-your-customer rules that govern the operation of many cryptocurrency exchanges and the traditional financial sector.

On-chain: data that are hosted publicly on the blockchain and visible to anyone with the skill, capacity and inclination to look.

Wallet addresses: public key addresses associated with Bitcoin and other cryptocurrencies. Wallets are both address information for those who wish to send information to a particular location and a digital representation of a holder of the private keys to an account (e.g. a person or organisation).

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Annex

The following Annex includes tables referenced in the text above.

Table 1. Total DNM revenue by year and percent change period over period

Year	Revenue flows (EUR)	Percent change (flows)	Transactions	Percent change (transactions)
2011	6 777 365	N/A	257 880	N/A
2012	89 029 739	1 214 %	1 618 608	528 %
2013	320 716 545	260 %	3 057 039	89 %
2014	388 585 254	21 %	5 465 443	79 %
2015	636 075 868	64 %	8 404 998	54 %
2016	1 095 707 989	72 %	18 074 563	115 %
2017	1 319 775 569	20 %	14 632 708	-19 %
2018	1 072 675 419	-19 %	7 563 221	-48 %
2019	2 120 924 536	98 %	10 897 514	44 %
2020	2 757 028 779	30 %	8 502 825	-22 %
2021	2 116 562 009	-23 %	3 776 928	-56 %

Table 2. Regional darknet market revenue flows in euro

Region	Class	Total flows (absolute)	Total flows (per 100 000)	Average flows (absolute)	Average flows (Per 100 000)
Eastern Neighbourhood	Total received (EUR)	183 299 482	250 909	1 131 478	1 549
Eastern Neighbourhood	Total sent (EUR)	104 106 695	142506	642 634	880
EU	Total received (EUR)	615 542 417	137 553	844 365	189
EU	Total sent (EUR)	284 942 846	63675	390 868	87
Russia	Total received (EUR)	336 881 438	233 532	12 477 090	8 649
Russia	Total sent (EUR)	298 927 415	207 221	11 071 386	7 675
Southern Neighbourhood	Total received (EUR)	51 470 610	21 138	190 632	78
Southern Neighbourhood	Total sent (EUR)	28 124 103	11 550	104 163	43
UK+NO+TR	Total received (EUR)	194 823 801	124 668	2 405 232	1539
UK+NO+TR	Total sent (EUR)	100 341 851	64 209	1 238 788	793
Western Balkans	Total received (EUR)	12 662 300	83 152	974 02	640
Western Balkans	Total sent (EUR)	6 271 841	40 520	48 245	312

Table 3. EU countries' per capita received, sent and total darknet market revenue engagement (in per capita euro)

Country	Rank	Mean rec.	Mean sent	Mean total	Total rec.	Total sent	Total	Population
Latvia	1	10.19	20.56	30.75	275.13	555.18	830.31	1907.69
Luxembourg	2	6.57	22.24	28.81	177.48	600.52	778.00	626.14
Slovenia	3	6.21	17.26	23.46	167.60	465.89	633.50	2094.26
Estonia	4	7.16	14.52	21.69	193.44	392.12	585.57	1328.98
Sweden	5	11.44	7.67	19.11	309.00	207.04	516.04	10316.16
Finland	6	5.31	12.99	18.31	143.44	350.82	494.26	5526.16
Malta	7	4.80	12.26	17.06	129.65	331.10	460.75	514.67
Netherlands	8	4.71	12.13	16.84	127.13	327.59	454.72	17393.01
Lithuania	9	5.68	10.67	16.35	153.25	288.21	441.46	2794.42
Cyprus	10	4.65	9.64	14.29	125.65	260.30	385.95	1202.97
Czechia	11	3.82	9.79	13.60	103.02	264.27	367.30	10685.38
Slovakia	12	3.69	9.17	12.87	99.67	247.69	347.36	5456.49
Bulgaria	13	3.79	8.39	12.18	102.46	226.43	328.89	6951.52
Ireland	14	3.63	7.86	11.50	98.11	212.32	310.43	4964.53
Austria	15	3.63	6.60	10.23	97.95	178.15	276.10	8898.56
Belgium	16	2.75	6.91	9.66	74.24	186.62	260.86	11522.49
Denmark	17	2.91	6.13	9.04	78.45	165.56	244.02	5822.91
Croatia	18	2.39	5.26	7.65	64.56	141.92	206.48	4056.23
Portugal	19	2.41	5.05	7.46	65.07	136.27	201.33	10295.91
Germany	20	1.77	4.69	6.46	47.71	126.65	174.36	83166.74
Poland	21	1.89	4.47	6.36	50.97	120.67	171.64	37958.14
France	22	1.91	3.87	5.78	51.69	104.43	156.12	67320.25
Spain	23	1.61	4.12	5.73	43.47	111.13	154.60	47242.54
Hungary	24	1.34	3.75	5.09	36.22	101.31	137.53	9760.45
Romania	25	1.57	3.13	4.70	42.47	84.53	126.99	19328.89
Greece	26	1.26	2.84	4.10	34.15	76.61	110.76	10718.57
Italy	27	0.92	2.01	2.93	24.75	54.35	79.10	59641.55

Notes: 1) All revenue and population data in thousands, 2) rec. is an abbreviation for received, 3) values rounded to 2 decimal places.

Table 4. UK, NO, TR per capita received, sent and total darknet market revenue engagement (in per capita euros)

Country	Rank	Mean rec.	Mean sent	Mean total	Total rec.	Total sent	Total	Population
Norway	1	6.10	10.15	16.25	164.79	273.96	438.76	5363.69
United Kingdom	2	3.23	5.73	8.96	87.09	154.75	241.84	67025.81
Turkey	3	1.46	3.37	4.84	39.50	91.09	130.58	83884.34

Notes: 1) All revenue and population data in thousands, 2) rec. is an abbreviation for received, 3) values rounded to 2 decimal places.

Table 5. Southern neighbourhood countries' per capita received, sent and total darknet market revenue engagement (in euros)

Country	Rank	Mean rec.	Mean sent	Mean total	Total rec.	Total sent	Total	Population
Israel	1	1.74	3.83	5.57	47.05	103.32	150.37	9 135.45
Tunisia	2	0.58	1.13	1.72	15.75	30.63	46.38	11 756.67
Morocco	3	0.58	0.86	1.44	15.66	23.17	38.83	36 691.16
Lebanon	4	0.54	0.87	1.41	14.53	23.51	38.04	6 840.58
Jordan	5	0.46	0.91	1.37	12.55	24.47	37.02	10 152.42
Algeria	6	0.38	0.80	1.18	10.30	21.61	31.91	43 452.05
Libya	7	0.27	0.63	0.91	7.37	17.11	24.49	6 824.37
Egypt	8	0.25	0.43	0.68	6.86	11.63	18.49	101 361.24
Syria	9	0.09	0.18	0.27	2.55	4.85	7.40	17 285.39
Palestine	Data not available							

Notes: 1) All revenue and population data in thousands, 2) rec. is an abbreviation for received, 3) values rounded to 2 decimal places.

Table 6. Eastern Neighbourhood countries' per capita received, sent and total darknet market revenue engagement (in euros)

Country	Rank	Mean rec.	Mean sent	Mean total	Total rec.	Total sent	Total	Population
Ukraine	1	6.76	12.06	18.82	182.46	325.66	508.12	44 260.45
Moldova	2	4.80	9.56	14.36	129.71	258.06	387.77	2 640.54
Belarus	3	5.13	8.52	13.65	138.60	230.01	368.61	9 408.36
Georgia	4	3.78	5.26	9.04	102.06	141.94	244.00	3 717.08
Armenia	5	1.77	3.27	5.03	47.69	88.16	135.86	2 960.48
Azerbaijan	6	0.62	1.04	1.66	16.66	28.03	44.69	10 067.20

Notes: 1) All revenue and population data in thousands, 2) rec is an abbreviation for received, 3) values rounded to 2 decimal places.

Table 7. Western Balkan countries' per capita received, sent and total darknet market revenue engagement (in euros)

Country	Rank	Min rec.	Min sent	Min total	Max rec.	Max sent	Max total	Mean rec.	Mean sent	Mean total	Total rec.	Total sent	Total	Population
Montenegro	1	1.32	1.68	3.38	22.18	47.51	53.26	4.94	10.60	15.54	133.40	286.31	419.71	621.87
Serbia	2	1.01	1.33	2.37	2.60	8.74	10.13	1.56	3.51	5.08	42.22	94.84	137.05	6 926.73
Bosnia and Herzegovina	3	0.40	0.59	1.47	5.95	4.04	9.99	1.49	1.95	3.44	40.16	52.62	92.78	3 290.91
Albania	4	0.32	0.26	0.57	3.47	7.57	8.47	0.93	1.95	2.88	25.20	52.56	77.76	2 845.97
North Macedonia	5	0.19	0.47	0.70	2.63	9.57	12.20	1.04	2.37	3.41	22.98	52.10	75.08	2 083.42

Notes: 1) All revenue and population data in thousands, 2) rec. is an abbreviation for received, 3) values rounded to 2 decimal places.

Table 8. Russian per capita received, sent and total darknet market revenue engagement (in euro)

Country	Rank	Min. rec.	Min. sent	Min. total	Max. rec.	Max. sent	Max. total	Mean rec.	Mean sent	Mean total	Total rec.	Total sent	Total	Population
Russia	1	4.57	3.41	8.59	11.59	13.63	22.63	7.67	8.65	16.32	207.22	233.53	440.75	144 255.17

Notes: 1) All revenue and population data in thousands, 2) rec. is an abbreviation for received, 3) values rounded to 2 decimal places.

Table 9. High level summary of cryptocurrency regulation in 54 countries

Country	Cryptocurrency officially banned	Exchanges KYC regulated	Exchanges anti-ML regulated
Austria	0	1	1
Belgium	0	1	1
Bulgaria	0	1	1
Croatia	0	1	1
Cyprus	0	1	1
Czechia	0	1	1
Denmark	0	1	1
Estonia	0	1	1
Finland	0	1	1
France	0	1	1
Germany	0	1	1
Greece	0	1	1
Hungary	0	1	1
Ireland	0	1	1
Italy	0	1	1
Latvia	0	1	1
Lithuania	0	1	1
Luxembourg	0	1	1
Malta	0	1	1
Netherlands	0	1	1
Poland	0	1	1
Portugal	0	1	1
Romania	0	1	1
Slovakia	0	1	1
Slovenia	0	1	1
Spain	0	0	1
Sweden	0	1	1
United Kingdom	0	1	1
Moldova	0	0	0
Belarus	0	1	1
Ukraine	0	1	1
Russia	0	1	1
Bosnia and Herzegovina	0	0	0
Serbia	0	1	1

Country	Cryptocurrency officially banned	Exchanges KYC regulated	Exchanges anti-ML regulated
Montenegro	0	0	0
Kosovo	1	0	0
Albania	0	1	1
North Macedonia	1	0	0
Algeria	1	0	0
Egypt	1	0	0
Israel	0	1	1
Jordan	1	0	0
Lebanon	1	0	0
Libya	1	0	0
Morocco	1	0	0
Palestine	1	0	0
Syria	0	0	0
Tunisia	0	0	0
Norway	0	1	1
Turkey	1	1	1
Armenia	0	0	0
Azerbaijan	0	0	0
Georgia	0	0	0