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Contracts as a reputation and trust management system

- Online illicit marketplaces are a key part of cybercrime economies.
- **HACK FORUMS:** the largest, longest-running, most well-known online cybercrime forum.
- Before June 2018, the unofficial marketplace raised concerns about scamming and frauds.

### Set-Up
- **Set-up** era begins
  - **Forming / Storming**
    - A dedicated marketplace opened: June 2018

### Stable
- **Stable** era begins
  - **Norming**
    - The contract system became mandatory: March 2019

### COVID-19
- **COVID-19** era begins
  - **Performing**
    - The global pandemic was declared by WHO: March 2020

#### Corresponding eras
- **How does this marketplace evolve over time?**
- **How do new users overcome the ‘cold start’ problem?**

### Tuckman’s stages of group development
- **Forming**
- **Storming**
- **Norming**
- **Performing**
A powerful dataset with nearly **200,000 transactions**

- Contractual (not actual) transactions.
- Contracts can be made **public** or **private**.
- Users are **incentivised** to use the system as it enables them to gain reputation and provides a certain level of **protection**.

Our dataset is **available** for academic researchers!
Huge uplifts at the beginning of STABLE and COVID-19 Era

• The number of new contracts and members tend to fluctuate together.

• Members were making more transactions each month during SET-UP era.

• The new policy adopted at the beginning of STABLE era made a huge effect to the market.

• Short-lived peak observed in COVID-19 era, even surpassed the previous peak.

• Established members also contribute more during COVID-19 era.

• Lockdown only intensified the market for a short period before it slipped back quickly.
Contracts are completed faster over time

- E1: Exchange
- E2: Purchase
- E3: Sale

Around 70 hours

Less than 10 hours

Suspected noise

Around 30 hours
The market is becoming more centralised

• Around top 5% of users are responsible for over 70% of contracts.
• Around 70% of contracts associated with a thread are linked to the top 30% of threads.
• Also highly centralised around influential individuals in term of contractual connectivity.

• Except the percentage of transactions that key threads made over created contracts, others increased from SET-UP to STABLE era.
• Rapid growths at the beginning of COVID-19 era, indicating the market became more centralised in response to the pandemic.
Currency exchange is the most popular trading activity

- Most users get involved in a few, one-off transaction.
- At all time, currency exchange is the most popular trading activity, followed by Giftcards and accounts/licenses.
- Other products: automated bots, hacking tutorials, remote access tools (RATs), and eWhoring packs.
- Downward trend due to users moving to private contracts during SET-UP era.
- A stimulus observed during COVID-19 era.
- A high demand for reputation seen in COVID-19 era with ‘hackforums-related’ taking the highest position.

the platform is clearly being used as a cash-out market
Bitcoin and PayPal are the most preferred payments

- Bitcoin and PayPal are the most preferred methods in term of both number of contracts and trading value.
- Again, downward trend during first 2 eras due to traders making the transaction private rather than public.
- Peaks at the beginning of STABLE era, in response to the new policy adopted.
- A stimulus seen during COVID-19 era, rather than a transformation.
- Cashapp dramatically increased in the last two months, to its highest ever ranking.
Trading value worth **millions** of US dollars!

- Extracted values from the **contractual** arrangements, rather than **actual** transactions.
- Manually checking **high-value** (exceeding $1,000) transactions.

again, highly centralised

**Private**

(unseen, estimated)

$5,192,143

$978,800

- **Peak** at the beginning of **STABLE** era. **Stimulus** during COVID-19 era. **SALE** outbreak at early of COVID-19 era.
The ‘cold start’ problem: How to escape?

- The ‘cold start’ problem: how to establish reputation while initially having no reputation?
- Predictor variables: users’ positive and negative ratings, number of disputed transactions, and length of participation since their first active post.
- Apply k-means clustering on a subset of members accepted their first contract in STABLE era.

Findings

- Majority of ‘cold starters’ build their reputation by participating in low-level currency exchanges.
- A small proportion of users instead offers products and services including: eWhoring packs, passive income schemes, hosting, botnets, software licenses.
Summary and conclusion: A big picture

- The contract system provides trust capabilities to facilitate trade between pseudonymous parties.
- Control becomes further centralised, with administrators acting as third-party arbitrators.
- New users overcome the ‘cold start’ problem by engaging in low-level currency exchanges.
- Clear evidence that it is a cash-out market, where most trades happening here are currency exchanges.

SET-UP Era

Users gradually shift to the new system with a large number of ‘small scale’ users involved in one-off transactions, and few ‘power-users’.

STABLE Era

Shift in composition and scale of the market when contracts become compulsory.
Growth of ‘business-to-consumer’ trades by ‘power-users’.

COVID-19 Era

Stimulus (not a transformation) observed: Same kinds of transactions, users, and behaviours, but at increased volumes. Market further concentrates around ‘power-users’. Forum posts indicate a period of mass boredom and economic change.

- Limitations: Lack of ground truth verification for transactions. High proportion of private contracts.

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Abstract
Trust and reputation play a core role in underground cybercrime markets, where participants are anonymous and there is little legal recourse for dispute arbitration. These underground markets, where user anonymity means that ’ripping’ or defrauding customers is common, have a wide range of activities (including criminal markets, where user anonymity means that ’ripping’ or defrauding customers is common. Underground markets have adapted to this problem of ’lemonisation’ by providing reputation and vouching services. More recently (June 2018) opened a dedicated marketplace to facilitate transaction, as well as ’power-users’ who make many transactions. Our dataset provides valuable insights into the economic ac-

1 INTRODUCTION

Online illicit marketplaces are a key part of the cybercrime economy; enabling malicious actors to arm their criminal activities, trade in commodities, and obtain compromised credit cards. Trust and reputation are key aspects of any market, but particularly so in cybercrime marketplaces, where users anonymity means that ’ripping’ or defrauding customers is common. Underground markets have adapted to this problem of ’lemonisation’ by providing reputation and vouching services, in many cases, and verified users to automate information asymmetry (30, 11, 10, 9, 8, 7). White paper research has focused on tender ratings and public feedback, these are few datasets as comprehensive as the one we analyse in this paper.

On the longest-running and most popular cybercrime forum, a market has been active for some time. We are interested in the longitudinal evolution of this market, rather than a snapshot. Indeed, does not offer a formal review service, however, in reaction to widespread concerns about the administrator recently June (19) opened a dedicated marketplace to facilitate the exchange and trade in goods and services where contracts are logged. This appears to be primarily used as a reputation and trust management system, on which fraudulent deals are able to form users on payment of a small fee. This trust adaptation prevents a unique opportunity for academic research. In this paper, we present an extensive analysis of this long-running market. We are particularly interested in exploring the longitudinal evolution of trust, conflict, and activity of different kinds – we consider this marketplaces to be an example of a disparate group of actors coming together (multidisciplinary interactions) as we look at joint interactions. Thus, the goal of this paper is to take a deeper look at cryptocurrencies development and its impact on the cybercrime market.

One dataset provides valuable insights into the economic activity linked to the forum, and has an underground marketplace evolve. The dataset begins from the start of this system, with details of goods traded, currency types and amount, time taken for payment. We are interested in the longitudinal evolution of this market, rather than a snapshot. Indeed, does not offer a formal review service, however, in reaction to widespread concerns about the administrator recently June (19) opened a dedicated marketplace to facilitate the exchange and trade in goods and services where contracts are logged. This appears to be primarily used as a reputation and trust management system, on which fraudulent deals are able to form users on payment of a small fee. This trust adaptation prevents a unique opportunity for academic research. In this paper, we present an extensive analysis of this long-running market. We are particularly interested in exploring the longitudinal evolution of trust, conflict, and activity of different kinds – we consider this marketplaces to be an example of a disparate group of actors coming together (multidisciplinary interactions) as we look at joint interactions. Thus, the goal of this paper is to take a deeper look at cryptocurrencies development and its impact on the cybercrime market.

• The evolution of latent groups (which has members sharing similar characteristics): behaviours of each group, how users move between groups and how they change across the lifetime of the market.

• The role of trust and reputation for ‘cold starters’ across all three eras.

• The contracts process in detail.
Our data is **available**, come to take it!

- To request the data, please contact us: director@cambridgecybercrime.uk
- Project webpage: [https://www.cl.cam.ac.uk/~vv301/cybermarket](https://www.cl.cam.ac.uk/~vv301/cybermarket)
- Other datasets we are sharing: [https://cambridgecybercrime.uk/datasets.html](https://cambridgecybercrime.uk/datasets.html)

**Ethical consideration**

- This dataset is collected on a **publicly** available online forum.
- Our work only studies the **collective** behaviours instead of **individual**.
- In our paper, the identity of **all** contracts, posts, threads, and users involved are **entirely** hidden.
- The dataset is widely provided for **academia** with subject to a **legal** agreement to prevent misuses.

Thank you for your attention!
Latent Class Transition: The evolution of latent groups