Economics of Security Assignment 4

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1 Introduction

In this assignment group 14 will present the reasoning behind the decision-making process of the actors around Silkroad1. In the previous assignments the differences between the actors were highlighted. This document provides a detailed description of the reasoning behind those differences.

2 Government / Law enforcement

2.1 Countermeasure

With the government and law enforcement, there is the choice between legalizing some of the drugs sold on the marketplace and pursuing the marketplace in order to attempt to bring it down. The most effective option is legalizing it, so the government is able to regulate it. This will get rid of the problem at its core, since buyers would not have the incentive anymore to buy the drugs on these marketplaces.

2.2 Distribution of costs and benefits

- **Customers**: For the customers this has benefits, since the price of some of the drugs will likely go down and the quality will increase. There are no real costs for the customers.
- **Distributors**: The cost for the distributors is that many customers will likely change to buying the legalized drugs, increasing the cost for the distributors. A possible benefit could be that some drugs get more attention (e.g. in the media), resulting in possibly a higher turnover.
- **Operators of Silkroad1**: This actor will also have costs, since the usage of Silkroad1 will decrease. Silkroad1 operators probably will see no benefit of this measure.
- **Postal Services**: For postal services, this measure will probably have no cost or benefit, since not much would change for them. It could be argued that less drugs will be sent via packages internationally, but since this is not the postal services' responsibility, they would not have any direct benefit because of this.
- **Customs**: For customs, the benefit is that less drugs will enter their country (since less drugs will be sold on illegal markets, and thus shipped internationally). There is no cost for customs.
- **(Il)legal competitors**: For this actor, the measure mentioned will mostly have a cost. If certain drugs become legalized and regulated, people will have less incentive to buy it a e.g. coffeeshops. For these competitors, there is little benefit.

2.3 Incentive analysis

The government and law enforcement definitely have the incentive to take this countermeasure. By implementing this, the illegal drug usage will go down, marketplaces such as Silkroad1 will be used less (and perhaps eventually disappear) and the government can regulate drug usage.

2.4 Externality reflection

Externalities for this actor could be the situation in other countries and the supply and demand factor of the drugs sold:

- **Other countries**: If a certain country would legalize the drugs, it's considered a negative externality for (surrounding) other countries, since illegal drug trading may increase the export/import to the legalized country and/or the drug usage as a whole.
- **Citizens of other countries**: Secondly, due to the legalization in one country, civilians in other countries may oppose against their own countries' regulation, because they may want the same legalized regulations. This might cause a negative externality for the governments and citizens of those countries.
- **Supply and demand**: Finally, if the supply and demand changes in the market, this has a big influence on the security issue, since markets like Silkroad1 have to adapt to this. For example, the Silkroad1 marketplace may become more active in a country that has no legalization regulation, which is a negative externality for that specific country.

3 Postal services

Postal services are actors since they facilitate the distribution of the illegal goods, while at the same time they may not know that they facilitate this. Several illegal goods traded at Silkroad1 can cause physical harm to the mailmen employed by the postal services, e.g. explosives, guns that are triggered and poorly packed drug packages. Since protection of employees is obliged by law, the postal services need to anticipate on this security issue in order to resolve this. In this case, postal services are assumed to process domestic mail.

3.1 Countermeasure

The countermeasure that is chosen is installing better illegal and/or dangerous good detection technology. These might be pure technological (e.g scanning devices) but could also be procedural (e.g random sample). Thus, every letter or package that is sent from a country to the same country will pass this security countermeasure. Obviously, the goal is to decrease the succession rate of the illegal good distributors, which is defined as the ratio of successful good deliveries to the customer. For a postal service, this means a higher detection rate of illegal and/or dangerous goods.

3.2 Distribution of costs and benefits

- **Customers**: The customers are the ones that want to receive the goods. So, they have no benefit, only a costs of not receiving their goods: the purchasing price.
- **Distributors**: The distributors will also have no benefit from this countermeasure, since more and more shipments will be stopped. This does not directly bring costs to the distributor, since the shipment is not guaranteed so the price payed can be kept. However, on the long term, if shipments from a specific distributor are constantly intercepted, bad reviews may cause a decrease in turnover for the distributor.
- **Operators of Silkroad1**: Again, no benefits here. If one postal service implements such countermeasures, they can advise distributors to not use specific postal services. On the long term, when nearly all packets are intercepted the, trust in online illegal goods trading can decrease and will thus reduce the total activity on the marketplace.
- **Postal Services**: The benefits will be increased safety for employees and not facilitating illegal goods trading. This will obviously come at a cost; such a calculation was made in the previous assignment.
- **Customs**: The benefit will be that when the postal services have good security countermeasures in place, eventually distributors will ignore the certain country so customs will experience less illegal packets shipped into the country.

- **(il)legal competitors**: They will benefit from the security countermeasure. As more shipments are being intercepted by postal companies customers will lose their trust in online marketplaces and will head to their (il)legal offline traders. A potential cost is the increase of the shipment fee, to compensate for the investment of the postal company. These costs will only be present when companies ship their products via mail.

3.3 Incentive analysis

There are several factors that determine the incentive of the postal companies:

- Protecting the mailmen is a critical factor. As an employer, this is a obligatory task by law. So if there are suspicions that dangerous goods are being transported via mail, the company should make countermeasures to prevent accidents.
- Transporting illegal but non-dangerous goods itself is not hurting the postal services' processes. For example, if several illegal pills are being transported in a letter, it does not directly impact the core business
- A postal service could argue that it is not their task to track and trace illegal goods, but it is a concern of the government. Since postal services are (mostly) private companies, intensive searches for illegal goods only cost money and thus are not attractive for the overall business model

Concluding, the authors think that private postal services need some kind of external incentive in order to really invest in this countermeasure. Such incentive would come from the government, since enforcing the law is one of their 'core businesses'. However, when the company is eager to protect its mailmen, they might invest in this countermeasure themselves out of safety concerns.

3.4 Externality reflection

- **Customs**: If postal services start using scanning devices, this is potentially a positive externality for the customs of that country. This is because actors from other countries have less incentive to send anything to that specific country, since they know it might be scanned and destroyed.
- **Other postal services**: If other postal services do not implement this countermeasure, distributes will likely switch to their services. This will shift the problem from one postal service to another which obviously is a negative externality for them.

4 Customs

Customs are considered actors since they can influence the international trade of illegal goods. Customs are, by law, obliged to filter out illegal goods shipped from other countries. Since it is infeasible to filter out all illegal goods flowing into a country, they for example examine large cargo shipments by taking random samples. For individual letters and packets they have other approaches.

4.1 Countermeasure

Customs of countries can also take measures to counter illegal marketplaces such as Silkroad1. Similar tao postal services, airport customs can scan incoming goods for drugs with scanning devices (or even detection dogs). This way, much illegal drugs can be prevented from entering the country. So, the concrete countermeasure is a more extensive search for illegal and/or dangerous goods in order to increase the detection rate.

4.2 Distribution of costs and benefits

- **Customers**: The costs/benefits are the same as in the postal service case in section 3.2.
- **Distributors**: The costs/benefits are the same as in the postal service case in section 3.2.
- **Operators of Silkroad1**: Since a whole country will be affected by the customs' countermeasure, there will be less frequent shipments to that specific country. This means that less users from that specific country will use Silkroad1, resulting in a reduced turnover for Silkroad1.
- **Postal services**: Postal services will benefit a lot from this countermeasure. Since they transport the letters and packets that have passed through customs to the final destination, they do not have to implement additional security measures for those international shipments. They can now rely on the strict border control of the customs.
- **(Il)legal competitors**: The costs and benefits are analogue to the costs and benefits in the postal service case.

4.3 Incentive analysis

This incentive is rather trivial. Since customs are in the end a governmental agency, they are obliged by law to stop as many illegal and/or dangerous goods as possible. The incentive comes directly from the government.

4.4 Externality reflection

- **Improved scanning**: If the customs improve the quality of their scanning and detection process of the import of drugs, this will result in a positive externality for postal services, since these postal services will have to make less effort to scan incoming packages containing drugs.

5 Actor security performance

5.1 Factors for variance

In the previous section, we have discussed possible countermeasures of different countries. For this section, as in the last assignment, we will focus on the Netherlands as the problem owner regarding cryptomarkets, specifically Silkroad1. We have identified a set of factors influencing our metrics about the security performance of the Netherlands. These factors are listed per metric below.

5.1.1 Top product categories listed

Over the measured period, there is an overall increase of product listings, probably due to cryptomarkets becoming more popular. This increase is reflected equally in the separate categories on Silkroad1. Some other influences on metrics are shown below.

Pills When compared to the other shipping sources of pills, the Netherlands is the country with the highest amount of listings, as shown in fig. 1a. However, it is difficult to conclude anything about this category as it is not defined what these pills exactly are. They could be, for instance, MDMA or other kinds of ecstasy, speed or prescription drugs. Therefore, we refer to the factors influencing the separate pill categories down below.

Weed There is relatively low amount of weed listings shipping from the Netherlands when compared to the global listings, which can be seen in fig. 1b. This can be explained with the fact that while the sale of weed is legalized in the Netherlands, the cultivation of weed is not. Therefore, all weed consumed in and exported from the Netherlands is either imported or produced on small hidden sites, as the Netherlands is a small and densely populated country, therefore cultivating weed on a large scale in secret is probably not

really feasible. Also, in 2013, most weed was seized in, and therefore probably also produced in, the US, Mexico and South America [2, p. 59].

Hash There is relatively high number of hash listings shipping from the Netherlands when compared to the global listings, as shown in fig. 1c. While most seizements of hash were in Southern Europe, Pakistan and Northern Africa [2, p. 59] in 2013, some of the major distribution flows from the production sites to the rest of Europe run through the Netherlands [2, p. 67].

MDMA The amount of MDMA listings shipping from the Netherlands is relatively high when compared to the global listings, which can be seen in fig. 1d. The Netherlands has a long history with MDMA. For instance, in the period from 2013 to 2015, the Netherlands, especially the provinces Noord Brabant and Limburg, had the largest amount of MDMA production sites in Europe [2, p. 125], and possibly even before and after this period.

Non-drug products There is a very low amount of non-drugs listings, eg. books, erotica and digital goods shipping from the Netherlands, as shown in figs. 1f to 1h. For the most part this is due to most listings in these categories having an unknown shipping origin, only some listings from North America and Russia. One explanation could be that the shipping country is used as a kind of quality seal for drug related categories, but this is probably not as relevant for other categories where there is no significant relation between the origin of a product and its quality. For instance, MDMA from the Netherlands is regarded more highly than from some other countries due its relatively high purity.

5.1.2 Amount of listings per category over time

Seeds There is a huge drop in the global seed listings from 29/03/2012 to 01/04/2012. All of these listings were shipped from the United Kingdom and were removed at approximately the same time, which is shown in fig. 2. Therefore, it can probably be assumed that these listings originate from a single producer that was taken down.

Local drops There are local drops in all listings around 06/03/2012, 09/04/2012, 26/05/2012 and 11/07/2012, as shown in fig. 3. These drops, and some more minor ones, are anomalies in the original data set, partially due to Silkroad1 being down for maintenance and for the other part due to failures of the collection tool and infrastructure as described in [1].

5.2 Data & statistical analysis

In this section multiple relations in the data are analyzed. The aim for each analysis is to reject the null hypothesis h_0 and therefore be able to accept the alternative hypothesis h_1. h_0 can be rejected when the $p-\text{value} \leq \alpha$, the significance level. For all statistical tests in this paper a significance level of $\alpha = 0.05$ is used.

5.2.1 Number of drug listings in the Netherlands versus the world

The first test we want to conduct is to find out whether there is a significant difference in average number of drug listings between the Netherlands and other countries in the world.

- h_0 = There is no significant difference in average number of drug listings between the Netherlands and other countries in the world.
- h_1 = There is a significant difference in average number of drug listings between the Netherlands and other countries in the world.

To investigate h_0 we compare the means of number of drug listings per country using an Independant-Samples T Test. The descriptive data can be found in table 1. The results of the t-test are shown in table 2. The $p-\text{value}$ is the value in the *Sig. (2-tailed)* column. $0.340 > 0.05$, which means h_0 cannot be rejected.

Therefore a significant difference in average number of drug listings between the Netherlands and other countries in the world cannot be proven.

Tab. 1: Descriptive data of average number of drug listings in the Netherlands and worldwide

	NL_or_Worldwide	N	Mean	Std. Deviation	Std. Error Mean
Drugs listings	Worldwide	76	299,93	1334,616	153,091
	The Netherlands	1	1590,00	.	.

Tab. 2: T-Test of average number of drug listings in the Netherlands and worldwide

		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Drug listings	Equal variances assumed	-,960	75	,340	-1290,066	1343,367
	Equal variances not assumed	.	.	.	-1290,066	.

5.2.2 Significant data

We conducted several statistical analyses in order to find significant results in the data. For instance, we investigated whether there is a significant difference between combinations of two continents in the average number of drug listings per country. The following hypotheses are worth discussing because the results were significant.

- h_0 = There is no significant difference in average number of drug listings per country between Europe and Africa.
- h_1 = There is a significant difference in average number of drug listings per country between Europe and Africa.

The descriptive statistics are available in table 3. The results of the statistical analysis are presented in table 4. The significance of Levene's Test for Equality of Variances is greater than α: $0,689 > 0,05$, which means that equal variances cannot be assumed. The *t-test with equal variances not assumed* results in a $p-$value of $0,048 < 0,05$. Therefore, we can reject h_0 and accept h_1, which means there is a significant difference in average number of drug listings per country between Europe and Africa. From the descriptive data in table 3 we derive that the number of drug listings per country in Europe is significantly larger than in Africa.

Tab. 3: Descriptive data of average number of drug listings per country in Europe and Africa

	Continent	N	Mean	Std. Deviation	Std. Error Mean
Drugs listings	Europe	28	235,64	562,077	106,22
	Africa	3	14,67	17,214	9,939

Tab. 4: T-Test of correlation average number of drug listings per country in Europe and Africa

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Drugs listings	Equal variances assumed	1,301	,263	,671	29	,508
	Equal variances not assumed			2,071	27,446	,048

6 Limitations

First, the data set only ranges from 03/02/2012 to 24/07/2012, which is less than six months. This period is too short to see the effects of implemented controls, significant market developments and larger takedowns of (drug) producers. The increases of listings in different product categories can be lead back to a general increase of popularity of cryptomarkets and, more specifically, Silkroad1.

Next, the data set consists of (mostly anonymized) product listings, feedback and forum posts from Silkroad1. Most of which only non-verifiable, user-supplied data, which makes it hard to draw significant conclusions from this data. This includes product categories, shipment data, feedback, etc. For instance, for many listings, the shipment data is unknown or the shipment locations overlap with others, eg. the EU versus the Netherlands.

Furthermore, as the data set is anonymized, even regarding product names and descriptions, it is not possible to reason about, for example, the prices per product, as it is unknown what amount of that product is sold per listing. For instance, a listing can offer 10 pills for a set prices, but a different listing for the same or a similar product could offer 100 pills, which will probably have a price that is increased with a similar factor.

Lastly, there are several anomalies in the data set for which the exact reason is unknown. In some cases, it is difficult to distinguish small anomalies in the collected data from events on the market, which, in many cases, are not even publicized.

7 Conclusion

In this assignment, group 14 described the reasoning behind the actors. Why do the different actors take different countermeasures? The government, postal services and customs have been investigated and their countermeasures have been described. A detailed cost/benefit analysis was made and the positive and negative externalities were identified. Furthermore, the incentives for the actors are presented which reveals why the actors really want to take these countermeasures. Lastly, we analysed the data using statistical analysis. Unfortunately we could not find significant results in relation to the metrics for our problem owner, however we did find other significant results which could be further investigated.

References

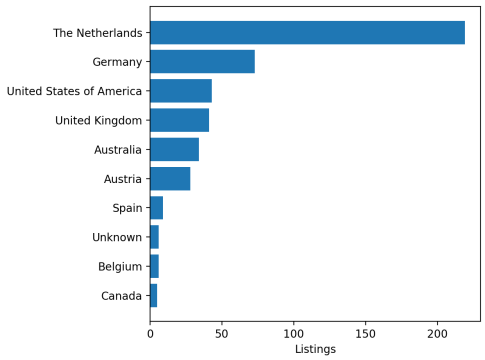
[1] Nicolas Christin. "Traveling the Silk Road: A measurement analysis of a large anonymous online marketplace". In: *CoRR* abs/1207.7139 (2012). URL: http://arxiv.org/abs/1207.7139.

[2] EMCDDA. *2016 EU Drug Markets Report*. http://www.emcdda.europa.eu/start/2016/drug-markets. (Accessed on 13/10/2017). Apr. 2016.

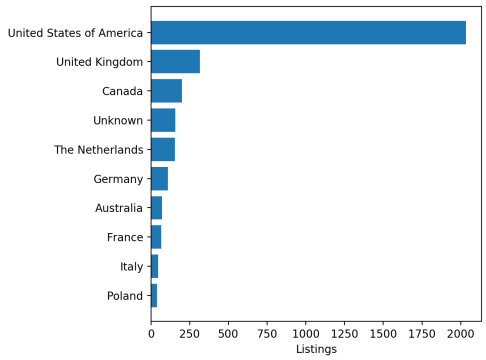
Appendices

A Metrics

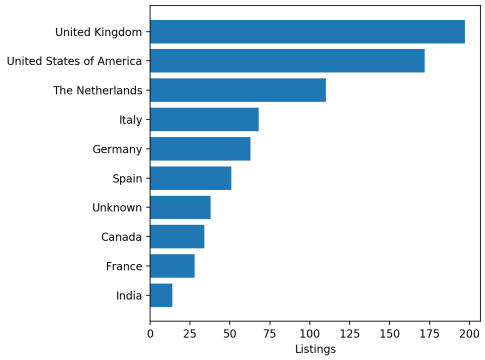
A.1 Top shipping countries per category



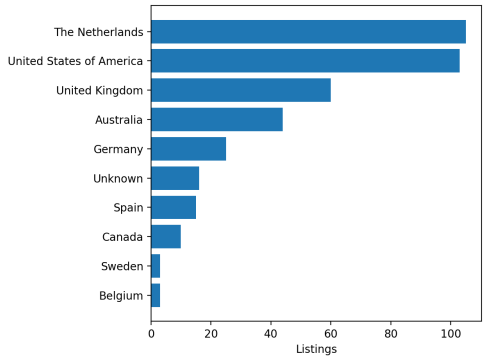
(a) Top shipping countries for pills



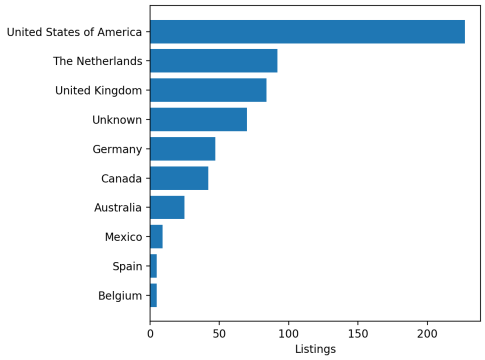
(b) Top shipping countries for weed



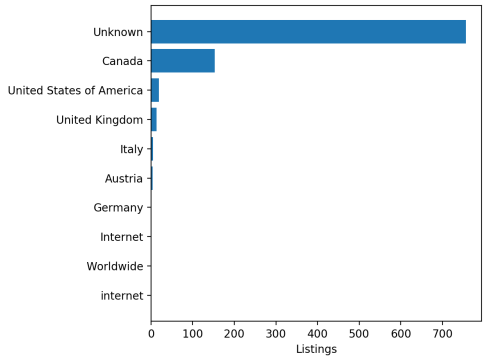
(c) Top shipping countries for hash



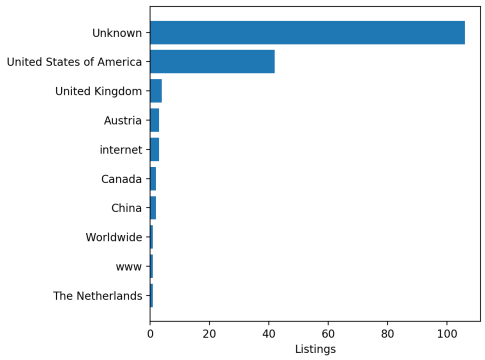
(d) Top shipping countries for MDMA



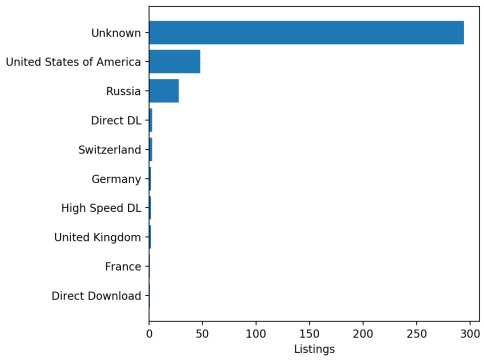
(e) Top shipping countries for cocaine



(f) Top shipping countries for books



(g) Top shipping countries for software, etc.



(h) Top shipping countries for erotica

A.2 Seed listings shipping from the UK versus anywhere

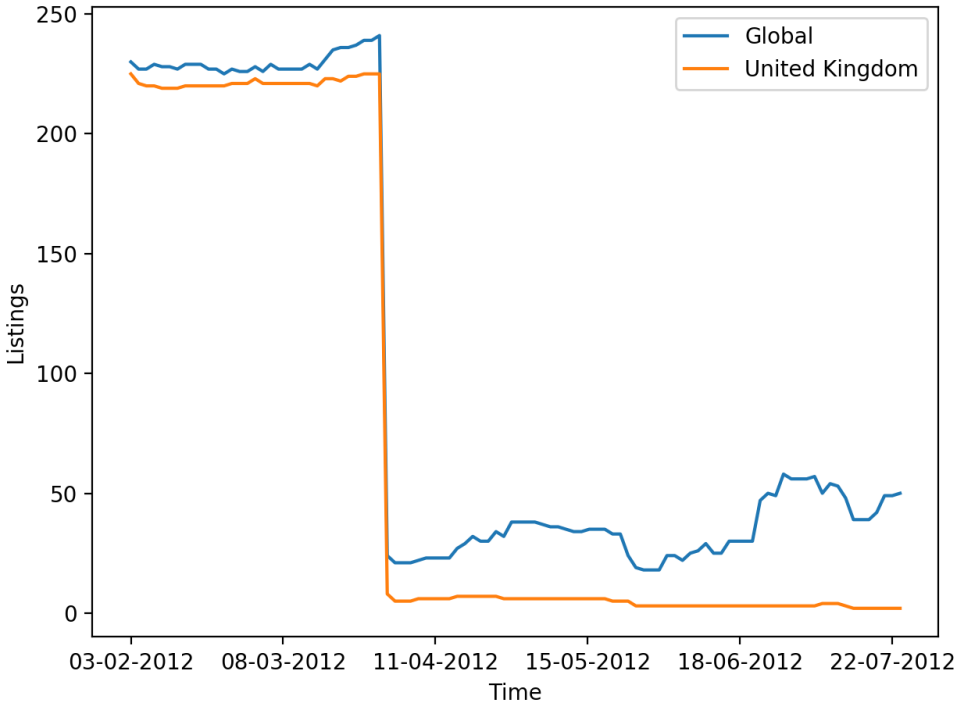


Fig. 2: Seed listings shipping from the UK versus anywhere

A.3 Total amount of listings over time

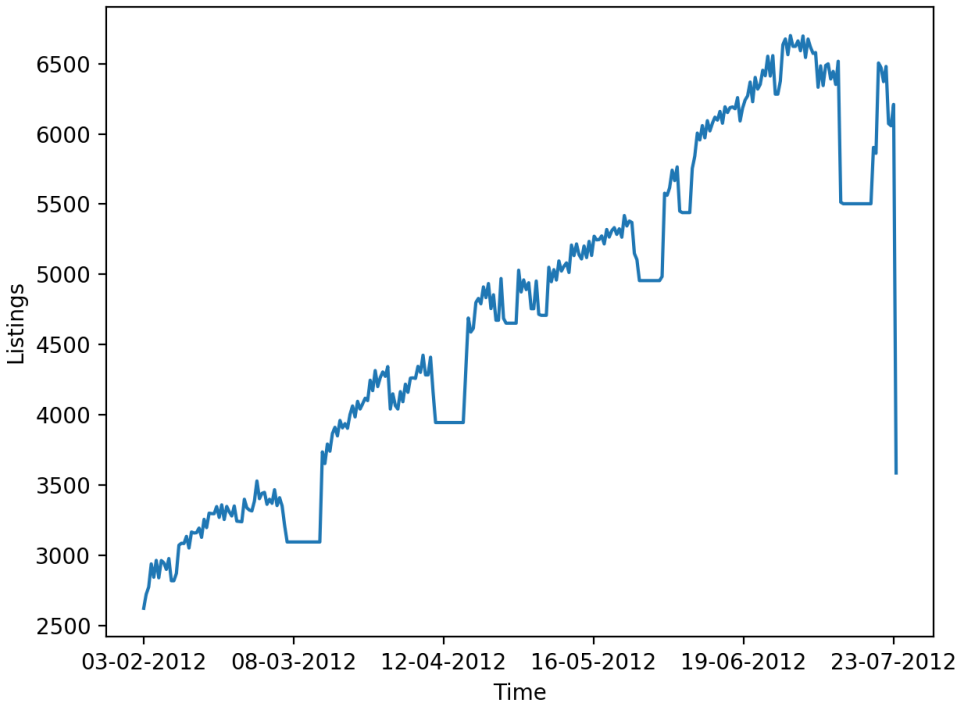


Fig. 3: Total amount of listings over time