Insurance Pricing in Dark Net Markets

Madeline Hess, Professor Robert Cooper
Quantitative Social Science, Dartmouth College

Abstract

Dark Net Markets create an ideal environment to study insurance mechanisms, because they face asymmetric information and express little to no contract enforcement. This study uses data collected on the Dream Market from 2015 and 2017 to explore the impact of reputation signaling through vendor ratings and contract enforcement through escrow options on product prices. I find that a one star increase in rating is associated with a 33.8% increase in the price of one gram of pure cocaine, and that product listings that offer escrow are associated with a 13.0% decrease in the price of one gram of pure cocaine. I conclude that buyers are willing to pay a premium to purchase insurance through reputation signaling and to avoid purchasing insurance through contract enforcement.

Key Words: Dark Net Markets, Insurance Premium, Reputation Signaling, Escrow

Existing Literature & Theoretical Framework

To counteract the asymmetric information and lack of contract enforcement and minimize scamming behavior, DNMs offer buyers:

1. Visibility into vendors' reputations through ratings and reviews, allowing for some insurance through reputation signaling;
2. The option of escrow, enabling insurance through improved contract enforcement.

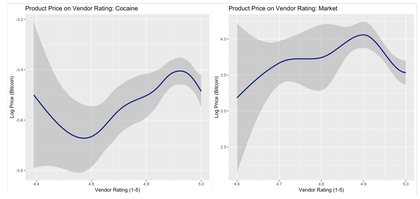
Classical economic theory leads us to believe that buyers will be willing to pay some premium in exchange for insurance that will maximize their expected value in a risky transaction (4). I seek to identify this premium as a price differential between products with and without the forms of insurance available on DNMs. Chun (2018) studied the price differential between products with and without escrow using Everling's (2017) data on cocaine prices and vendor information (2, 3). He found that product listings offering escrow were associated with an 11.2% increase in price (2). This builds on Chun's (2018) findings and aims to diagnose the relationship between price and seller rating in the same dataset to elucidate buyers' willingness to pay for insurance through reputation signaling. As a means of validating my findings, I then expand the analysis to consider a full market sample.

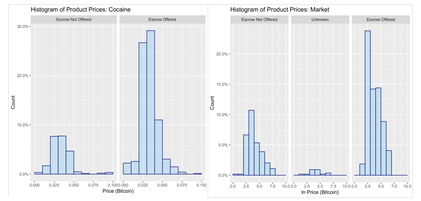
Conclusions

Main Findings:

I find increased ratings are associated with increased prices, and reject my null hypothesis.

Note: Ratings are biased upwards so error is introduced when ratings drop below 4.6.





Ancillary Findings:

In contrast with Chun (2018), I find higher prices associated with products that do not offer escrow.

Mean of Product Prices (Btc):

Escrow?	Yes	No
Cocaine	0.815	2.17
Market	0.518	0.609

Methods

Data

Everling Data:
Skip Everling, a data scientist and researcher at the artificial intelligence company Clarifai, constructed a dataset with roughly 1,500 product listings for cocaine and accompanying vendor reviews with a scrape of the dark net in July of 2017 (2). I use this dataset in my preferred specification, so as to have comparable results with Chun (2018)

Original Data Constructed from Branwen et al. DNM Archives:
Branwen et al. released a publicly available dataset considering 3 years of near daily web crawls of 89 DNMs. I constructed a dataset of 800 observations of listings for all product categories and vendor information using a simple random sample of approximately 30 observations per day. I scraped this information from the Dream Market archives (Branwen et al.) covering January 1st 2015 through July 3rd 2015 (1). I use this dataset as a robustness check.

Analysis

Main Estimating Equation:

$$y = \beta_0 + \beta_1 x + \beta_2 z + \epsilon$$

- y = Price of product in Bitcoin (natural log)
- x = Rating of product vendor
- z = Vector of controls, including escrow and number of successful transactions completed by the vendor
- β_0, β_1 and β_2 are constants. β_1 is my main coefficient of interest.
- ϵ = Error term

Main Null Hypothesis:
There will be no change in product price associated with changes in vendor rating.

Results

Main Findings:

- In the preferred specification (see column 4), I find a one star increase in vendor rating is associated with a 33.8% increase in listed price, with a 95% confidence interval of 7.7% to 59.9%
- In the preferred specification, I also find that offering escrow is associated with a 13.0% decrease in listed price
- These results conflict Chun (2018). I argue this is because purchasing escrow exposes buyers to exit scam risk from the market.
- These results indicate buyers place trust in other buyers and are willing to purchase insurance through reputation signaling.

Robustness Check:

- When this analysis is expanded to the full market, I find a one star increase in rating is associated with a 134.8% decrease in price
- This indicates that this theory and analysis do not have complete external validity, and more testing is necessary
- This change in result could be because of variation across product categories that drives buyers behave differently

Table 1: Main Specification on Cocaine Market Data

	(1)	(2)	(3)	(4)
	ln(price)	ln(price)	ln(price)	ln(price)
Seller Rating	0.370***	0.352***	0.354***	0.338**
	(0.133)	(0.133)	(0.133)	(0.133)
Escrow offered? Yes		-0.132***		-0.130***
		(0.0373)		(0.0373)
Number of Vendor Transactions			0.0000568*	0.0000540*
			(0.0000306)	(0.0000304)
Constant	-5.273***	-5.088***	-5.217***	-5.038***
	(0.649)	(0.649)	(0.650)	(0.649)
N	1504	1504	1504	1504

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Robustness Check: Main Specification on All Market Data

	(1)	(2)	(3)	(4)
	ln(price)	ln(price)	ln(price)	ln(price)
Seller Rating	-0.813	-0.862	-0.861	-1.348**
	(0.587)	(0.615)	(0.608)	(0.641)
Escrow offered? Unknown		-0.569		-0.840*
		(0.427)		(0.438)
Escrow offered? Yes		-0.411***		-0.607***
		(0.124)		(0.146)
Number of Vendor Transactions			-0.000178	-0.00171**
			(0.000574)	(0.000671)
_cons	7.756***	8.282***	8.010***	10.98***
	(2.885)	(3.024)	(3.002)	(3.189)
N	518	518	518	518

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Future Directions

Improved Web Scraping

The change in direction of the affect of vendor rating on product price between the cocaine market and full market gives rise for further research. Limitations to data availability through web scraping prevented me from controlling for product category in my full market analysis. Controlling for different trends across product categories could change the direction of the effect, causing it to align with the results of this study.

Multiple Hypothesis Testing

The high significance level of both the ratings and escrow variables is promising, but is not significant to the level necessary to pass the Bonferroni correction. A repetition of this analysis on a wider dataset could enable stronger multiple hypothesis testing.

Works Cited

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