

Measuring the Level of Online Transaction Fraud and the Feature Distribution based on the E-commerce Chain: An Empirical Analysis of E-commerce Fraud in China

Weiqun Zhang^{1,2}, Alex Y.-S. Lin³, Yan Tian², Qi Li¹

¹. School of Economics and Finance, Xi'an Jiaotong University, Xi'an, Shaanxi Province 710049, China

². School of Statistics, Xi'an University of Finance and Economics, Xi'an, Shaanxi Province 710100, China

³. School of Business, Beijing Institute of Technology (Zhuhai), Zhuhai, Guangdong Province 519088, China
alexlin218@gmail.com

Abstract: This article aims to define the concept of the commercial fraud and expand the theoretical model of business chain based on the deficiency of the level of online transaction fraud and distribution measurement. Based on the concept, the authors designed the measurement tools for online transaction level and the distribution on the nodes of business chain from the amount of commercial frauds and fraud level. This paper uses the survey data to analyze the level of online transaction fraud and distribution in China. The results of this study show that the amount of online transaction fraud in China is higher than the occurrences of fraud, and the fraud behavior mostly occurs on the front-end of business chain. The study also shows that the level of fraud among female participants is higher than male, yet there is no significant difference in the fraud level for participants with different cultural backgrounds. [Wei-qun Zhang, Alex Y.-S. Lin, Yan Tian, Qi Li. **Measuring the Level of Online Transaction Fraud and the Feature Distribution based on the E-commerce Chain: An Empirical Analysis of E-commerce Fraud in China.** *Life Sci J* 2015;12(1):225-228]. (ISSN:1097-8135). <http://www.lifesciencesite.com>. 30

Keywords: E-commerce chain; online transaction; the level of fraud; measurement tool design

1. Introduction

In the last few years, e-commerce in China is growing fast. According to the "China's Internet Development Statistical Report" released by the China Internet Network Information Center (CNNIC) in 2014, China has had 618 million Internet users by the end of December 2013, and the Internet penetration rate was 45.8%. In 2012, the total value of China's e-commerce market reached RMB 8.1 trillion. Business applications remain a high developmental speed, which is particularly prominent in online shopping as well as group purchase, meanwhile, the e-commerce market is growing at an average rate of 30% annually (China Internet Network Information Center [CNNIC], 2014). However, e-commerce fraud has become an inevitable issue for a country, enterprises and consumers; it also attracts attention from academics and industries. According to the references, the amount of e-commerce fraud globally accounts for 5-7% of company revenue in average. The theoretical research in e-commerce fraud behavior also becomes a general research issue; especially focuses on online reputation, confidence measurement, evaluation method and the measurement of fraud level.

Studies on online transaction fraud features are common. Milne, G.R. and Culnan M.J. (2004) conducted research about customer's identification behavior regarding information on the Internet, analyzed the impact factors of consumers' choice. Through literature research, Monswé, T.P., Dellaert, B.G.C., and Ruyter, K.D (2004) studied consumers' choice behavior on online transaction. Regarding to

the influences of online transaction fraud on the product final price, Mamata Jenamani, Aurobinda Routray, Vikash Singh (2011) did the research about quantitative identification of fraudulent bidding behavior, and chose appropriate information to measure customer features.

Literature for the level of online transaction fraud is as follows: Charles R. Tittle, David A. Ward, and Harold G. Grasmick (2003) used survey data to study and analyze the measurement indicators of cognition and behavior, hence proposed that the measurement of cognition and behavior based on self-control theory are consistent. Matti Keloharju, Juhani T. Linnainmaa, Mark Grinblatt. IQ (2010) did the research about offline transaction behavior, concluding the types and features of offline transaction behavior, but the research didn't measure the offline transaction behavior and its features.

From the aspect of general process of online credit issues, the study of online transaction fraud begins with the theoretical research on the measurement and identification of online fraud features, and then processes the theoretical research of controlling and restraint mechanisms for online fraud behavior again. Currently, only a few literatures related to the measurement of fraud behavior features can be found. The measurement studies on basic concept of online transaction fraud can scaffold the research on the identification, control and credit mechanism of online transaction fraud. Meanwhile, commerce process is a transaction chain composed of a series of transaction behaviors. The analysis of fraud

in commerce process shall be done from a micro view of business chain. Therefore, based on the online transaction process, this article aims to study the fraud features in various links of business activities, develop the concept model of the e-commerce chain, and conduct research about measurement method of fraud behavior and fraud level based on the analytical framework of e-commerce chain.

2. Model of E-commerce Chain

Li Qi (2004) proposed the concept model of e-commerce chain and did the intensive research regarding its contents and features. The authors think that e-commerce chain is a comprehensive framework describing the transaction (commerce) process of e-commerce, also reflecting the general framework of e-commerce activities. Based on the e-commerce analytical framework to do research, and provide analytical methods for instruction to major link of e-commerce chain, thus continue the research on the theory of e-commerce chain.

Li Qi and Zhang Xianfeng (2007) studied the analytical framework based on e-commerce chain, logistics, cash flow, information flow and employee flow, expanded the intension and extension of e-commerce chain theory, also proposed the latest research framework based on e-commerce. By putting cash, products, information and employees under the framework of business chain nodes; the study developed an analytical theory of static expansion model for e-commerce, offering a more comprehensive research framework for e-commerce theory. The research about the intension and extension of e-commerce chain theory is still proceeding with real e-commerce practice. Moreover, the research that elaborates and divides the nodes participating in business chain combining e-commerce is currently under developing.

Based on the above information, this article considers that e-commerce activity is composed of a series of continuous behaviors by participants. Each behavior has a different duration of existence, and there is a sequential relation among the behaviors. To analyze the behavioral features of e-commerce activities, this paper categorizes and divides the behaviors of e-commerce activities based on the contents and purposes hence form a number of macro behaviors that can be easily identified. Behaviors with the same content and purpose are categorized and defined as a concrete behavior type. From a comprehensive aspect of business activities, this paper proposes that legal identities of traders, the distribution of commodities and services and the commercial evaluation are also necessary elements in business activities. A complete business activity should be included in the links of e-commerce chain. According to research and analysis on business

activity behaviors, the authors identify ten major behaviors in e-commerce activities based on the content and feature of behaviors, including identification confirmation, commodity display, negotiation, agreement signing, transaction, commodity (service) distribution, transaction confirmation, after sale service and dispute resolution. The concept model of e-commerce chain I is showed in Figure 1. For this reason, e-commerce chain is regarded as a complete e-commerce activity participated by real and unreal participants (either parties or multiple parties) to perform different behaviors for the specific commercial purpose, and is divided into a number of segments composed of sequential behavioral nodes.

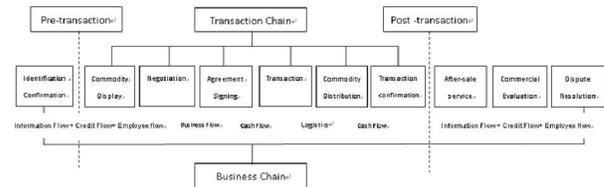


Figure 1. The concept model of E-commerce chain

3. Measurement Index and Design

By conducting research about fraud behaviors on various nodes of the business chain, it is beneficial to identify the feature and level of the occurrence of different fraud behaviors. It also describes the fraud distribution within the whole transaction chain, supports the development of business fraud behavior control and credit mechanism with basic theory.

Table 1. Measurement index system of online transaction fraud

Evaluation items	Evaluation contents	Evaluation indexes	Remarks
Overall evaluation of business fraud	Total amount of business fraud level	Total fraud occurrence rate	Total fraud occurrence rate = Total occurrence of fraud transactions / Total number of transactions
	Total level of business fraud level	Fraud amount rate	Fraud amount rate = Total amount of fraudulent transactions involve / Total amount of transactions
Fraud evaluation of each nodes on business chain	Level of the number of frauds on each node	Occurrence rate of fraud on each node	Occurrence rate of fraud on each node = The number of frauds on nodes / The total number of frauds
	Level of the amount of fraud on each node	Fraud amount rate on each node	Fraud amount rate on each node = The amount of fraud on each node / The total amount of frauds

The measurement of the total level of fraud behavior needs to consider the frequency level of fraud as well as the impact level of fraud, meanwhile, the measurement of total effect should also consider the distribution of fraud behavior on the nodes. This paper designs indexes that measures online fraud frequency and level, and the fraud frequency distributed over the nodes of business chain and its level.

The measurement of fraud behavior level on the nodes of business chain should consider both the number and amount of frauds. So Formula 1 is developed for calculating the fraud occurrence and level on each node:

$$\sigma(a_{ii}) = (\mu(a_{ii}^{(Y)}) \cdot \mu'(a_{ii}^{(Y)}))^{1/2} \quad (1)$$

In this formula, $\mu(a_{ii}^{(Y)})$ represents the measurement of the fraud amount level for the fraud behavior $a_{ii}^{(Y)}$ on the node ti ; $\sigma(a_{ii})$ represents the general fraud level of the fraud behavior $a_{ii}^{(Y)}$ on the node ti . Besides, the sum of the occurrence level and amount level within the whole business process is composed of the sum of fraud level on each node of the business chain. The formula is as follows:

$$\mu(a^{(Y)}) = \sum \mu(a_{ii}^{(Y)}), \mu'(a^{(Y)}) = \sum \mu'(a_{ii}^{(Y)})$$

By considering the distribution of fraud behavior impact on the nodes, this paper develops the tool that measures the impact of the discretization of fraud behaviors on nodes, as shown in the following formula:

$$\Delta = \sum \lambda^E(t) \cdot \sigma(a_{ii}) \quad (2)$$

In this formula, $\lambda^E(t)$ is the distribution percentage of fraud behavior on node ti , while Δ represents the effect level of fraud behaviors. If the fraud behavior has a situation of monotone decreasing in terms of its distribution on the nodes, it means that the function $\lambda^E(t)$ is a monotonically decreasing function. The impact of fraud behaviors on the measurement tool Δ will determine the following conditions: when $\Delta > 1$, fraud behavior mainly occurs on the front-end of e-commerce chain.; when $\Delta < 1$, fraud behavior will occur on the back-end of e-commerce chain; when $\Delta = 1$, the fraud behavior distributes uniformly on each nodes of e-commerce chain.

5. Quantitative Evaluation

This paper adopts the survey data of the "Comparative Study of Online and Offline Transaction Fraud based on the Business Chain" conducted by the E-commerce & Governmental Affairs Key Laboratory of Xi'an Jiaotong University and Alibaba Group to carry out an empirical study. Our project selected six areas in our country to investigate the occurrence rate of online transaction fraud among residents from cities and villages. The areas include municipalities directly under central government—Beijing, Shanghai and Chongqing; provincial capital cities—Taiyuan, Zhengzhou, Wuhan, Xi'an and Chengdu, and major regional cities—Xiamen and Dalian. 4,836 valid questionnaires

are recovered. The validity and reliability of the questionnaires recovered meet the analysis requirement. Besides, to improve the representativeness and inference accuracy of the questionnaire results, we adopted weighting process based on the age structure, sex ratio as well as the resident distribution in urban and rural areas of the population census in China.

This paper divided the total questionnaire samples into two groups to evaluate the questionnaire reliability. The reliability of the questionnaire samples is measured through the correlation of two groups of samples. We chose five major indicators, including the number of respondents' online transactions, the total amount of transactions, the number of frauds, the amount of fraud, and the amount of online consumption to measure the reliability level. The coefficient of Cronbach's Alpha (Standardized) is 0.826. By conducting statistical test of questionnaire validity through factor analysis of related statistics, Bartlett's Approx. Chi-Square statistic test was 886.519 (SIG=0.000). The results indicate that the questionnaire has better reliability and validity.

By analyzing the data of cases of online transactions among the 4,892 questionnaire recovered with the online transaction fraud measurement method and tool designed in this study, we evaluated the fraud level from the fraud occurrence rate and the fraud degree rate. The distribution of online transaction frauds on various nodes of business chain reflects the distribution of fraud occurrence. Through analysis of the fraud distribution on business chain, we can understand the central tendency of the occurrence of

online fraud. We assume that the measure tool $\lambda^E(t)$ has a linear decreasing tendency, in other words, we propose that the fraud occurs in the front end of business chain, which has a greater effect than fraud occurs in the back end of business chain. The result of online transaction fraud data analysis is shown in Table 2. Online and Offline Transaction Fraud based on the Business Chain.

Through the statistical analysis of the data, we learned that the occurrence rate of fraud among every 1,000 online trading cases is 4.22, and the fraud amount ratio is 5.76 per 1,000 RMB. The comprehensive level of fraud measured with formula (1) is 4.93. The fraud amount ratio per 1,000 RMB is higher than the occurrence rate of fraud among every 1,000 online trading cases, showing that the deceivers tend to choose goods with higher prices to commit fraud. In terms of online transaction fraud, the display of goods, communication & negotiation, and the signing of agreement have significantly higher rate than other nodes regarding the occurrence rate or the amount ratio. As for identity verification, transaction

confirmation and business evaluation, the occurrence rate is higher than the fraud amount ratio; while opposite situation happens for other nodes.

We also applied formula (2) to measure the distribution features of online transaction fraud on business chain. The evaluation of aggregation level of online fraud is shown in Table 3.

Table 2. The Level and Distribution of Online Transaction Fraud Based on the Business Chain

Overall evaluation of online transactions fraud ^a	The comprehensive level of fraud ^b	The occurrence rate of fraud ^c	The overall fraud amount ratio ^d
	4.93% ^a	4.22% ^a	5.76% ^a
Evaluation of distribution features of online transaction fraud on business chain ^e	Nodes of business chain ^f	Distribution structure of the fraud occurrence on various nodes ^g	Distribution structure of the fraud amount on various nodes ^h
	Identity verification ⁱ	8.76% ^a	7.34% ^a
	The display of goods ^j	23.15% ^a	24.92% ^a
	Communication and negotiation ^k	27.88% ^a	28.93% ^a
	The signing of agreement ^l	14.60% ^a	14.89% ^a
	Transaction payment ^m	5.08% ^a	5.13% ^a
	Distribution of goods ⁿ	3.41% ^a	3.78% ^a
	Transaction confirmation ^o	1.67% ^a	1.35% ^a
	After-sales service ^p	7.28% ^a	8.38% ^a
	Business evaluation ^q	7.69% ^a	4.82% ^a
Disputes management ^r	0.47% ^a	0.46% ^a	

Table 3. The Node Distribution Coefficient of Online Transaction Fraud

Model ^a	Distribution coefficient of online trading fraud ^b	
Item	Distribution structure of fraud occurrence in different nodes ^c	Distribution structure of fraud amount in different nodes ^d
Distribution structure coefficient ^e	1.2965 ^a	1.3158 ^a

According to Table 3, both the fraud frequency distribution and the coefficient of amount structure is greater than 1 for online trading, indicating that the online transaction fraud mostly occurs at the front end of business chain. In other words, online transaction fraud has a concentrated tendency at the front end of business chain.

5. Conclusion

This paper redefines the concept of business fraud based on the theoretical model of extending business chain. Based on the abovementioned theory, we designed measurement tools for online transaction from two dimensions of business fraud-- number and level. We also designed measurement tools for the distribution of fraud on the nodes of business chain. In this paper, we used survey data to evaluate the level and distribution of online transaction fraud in China. The results showed that the amount level of China's online transaction fraud is higher than the occurrence rate, and the fraud behavior often occurs in the front end of the business chain. Because the research of e-commerce credit follows process of identification,

control, and system construction, based on the measure research, a further research on theories of identification, control and system construction of business fraud on the business chain is required. E-commerce may have a positive development only with a control on the level and distribution of various fraud features.

Acknowledgements:

Authors are grateful to the E-commerce & Governmental Affairs Key Laboratory of Xi'an Jiaotong University and Alibaba Group for related support to carry out this work.

Corresponding Author:

Dr. Alex Y.-S. Lin

School of Business

Beijing Institute of Technology (Zhuhai)

Zhuhai, Guangdong Province 519088, China

Email: alexlin218@gmail.com

References

- China Internet Network Information Center (CNNIC), Statistical report on China's Internet Network development (the 33rd time), 2014, 01.
- G.R. Milne, and M.J. Culnan. Strategies for reducing online privacy risks: Why consumers read (or don't read) online privacy notices. *Journal of Interactive Marketing*, 2004, 18(3): 15-19.
- Monsuwé, T.P., Dellaert, B.G.C., and Ruyter, K.D. What Drives Consumers to Shop Online? A Literature Review. *International Journal of Service Industry Management*. 2004, 15(1):102-121.
- Mamata Jenamani, Aurobinda Routray, Vikash Singh, A procedure using support vector data description and mutual information for end price assessment in online C2C auction, *Electronic Commerce Research* September 2011, Volume 11, Issue 3, pp 321-340.
- Charles R. Tittle, David A. Ward, Harold G. Grasmick, Self-Control and Crime/Deviance: Cognitive vs. Behavioral Measures, *Journal of Quantitative Criminology*, December 2003, Volume 19, Issue 4, pp 333-365.
- Matti Keloharju, Juhani T. Linnainmaa, Mark Grinblatt. IQ, Trading Behavior, and Performance. *Journal of Financial Economics*, Forthcoming. EFA 2010 Frankfurt Meetings Paper, Chicago Booth Research Paper No. 09-33.
- Li Qi, An Introduction to E-Commerce, Higher Education Press, September, 2004.
- Li Qi, Zhang Xianfeng, A Comprehensive Analysis Framework of E-Commerce Theory and Practice Regarding Transactions, *E-Commerce*, 2007, 07, No. 17.