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A Study on Trust of E-commerce Market Based on Multi-agents Model

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Abstract: The process of the trust production and transfer is both stochastic and rational. In this article, we analyze the characters of this process in consumer's social networks, by dividing consumers and merchants into two types: Risk-aversion type and Risk-neutral type for consumers, high-grade and low-grade for merchants respectively. Based on multi-agent NETLogo system, three kinds of virtual social networks are constructed, which are the risk-neutral without institution, risk-aversion without institution, risk-aversion but with good institution. The rules of the production and transfer of trust in consumer-to-consumer and merchant-to-consumers are defined. Based on a series of computational experiments and statistical comparison, we draw a conclusion that the characters of consumers do not change the trend of e-business market scale, but only change the equilibrium value. On the other hand, a risk-aversion with good institutional society can boost market to have a highly upward trend and be self-stable. Consequentially, this article indirectly proved of the essentials for establishing the institution-based trust.

Keywords: Complex networks, Multi-agents, Computational experiments, Institution-based trust, Emergence

1. INTRODUCTION

Rapid growth of the e-commerce market in China has forced marketing researchers to seek more creative methods to reveal the law of e-commerce market. CNNIC (China Internet Network Information Center) reported that the number of Chinese internet users reached 384 million, up 28.9% in 2009, and continuously to increase to 457 million, up 34.3% in 2010 [1]. According to U.S. census bureau, the number is more than the entire population of U.S., which is 308 million in 2010 and ranks the third in world population [2]. Has this e-commerce market reached its full potential? To what extent will the market be vulnered, once it has been jeopardized by someone who is proved to be dishonest and unreliable? What we can do to protect e-commerce market from volatility and diminishing?

As market researchers placed greater emphasis on e-commerce, online trust has assumed to be a central role in the development of marketing theory. Research on online trust primarily includes two main fields. (1) Elements correlative analysis (e.g., Yan to show that the usefulness and online-shopping experience has strongly positive correlation) [3]. (2) Structure analysis to classify the structures and the systems. (e.g., Peking university network economic centre to clarify the definition of credit, trust, reputation and trust, and classify the online trusts to four kinds-"positive", "negative", "default" and "surpass") [4].

In this article, we advocate a new approach to analyze the rules of e-commerce market, relying on computational experiments by synthesizing insights from multiple social science theories in a multi-agent model [5]. The computational experiment makes the analyses more precise and practical.

This study contributes, in academic views, to the online market research as to the comparison of how the market scale associated with the characteristic-based trust and the institutional-based trust. Furthermore, in practical views, it provides the related organizations an effective solution to keep the market self-stable and upward.

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The remainder of our work is organized as follows: In section 2, we have a literature review of trust theories and e-commerce theories, as basic principles to the production and transfer of trust. And in section 3, we describe the rules of interactions of the agents in the models of the computational experiments. Section 4 provides the outcomes of the experiment and makes a statistical comparison to draw a conclusion.

2. LITERATURE REVIEW

Trust has received a great deal of attention in the disciplines of psychology, sociology, political science, economics, history and socio-biology. Each discipline offers unique insights into the nature of trust and the processes through which it develops. It is not the intention of this paper to discuss in depth its definitions and differences as viewed by different researchers or disciplines. In this paper, we apply some widely-accepted views in the process of trust produce and transfer to build a virtual experimental environment.

2.1 Production of trust

Zucker (1986) discussed 3 central modes of trust production: (1) process-based, tied to past or expected exchange; (2) characteristic-based, tied to person, based on social characteristics; (3) institutional-based, tied to formal societal structures, based on individual or firm-specific attributes or on intermediary mechanisms [6].

Noteberg (1999) [7] made an empirical research to prove that ,for new users, recommended trust can be used to establish the initial trust relationship and a strong trust relationship can be established with a vendor through direct experience, in line with Zucker's modes of trust production of characteristic-based and process-based.

2.2 E-commerce trust

The e-commerce market is different from the traditional market in many ways. One distinctive point is that the ranges of exchange partner are changing from acquaintances to strangers. Traditionally, merchants and consumers are confined by the range of distance. But now, merchants and consumers are no longer bound by geographical boundaries. From the consumer's view, stranger providers from all over the world, with different culture and intentions, swarm into the market.

Most of the research on online trust can be classified to two classes. One is to research the trust-production mechanisms. The other one is to research the relations of some factors to trusts. Typically, Dan J. Kim (2005) provides us a systematic introduction of on-line trust. He put forward the framework that trust is formed through the interaction of four different entities in online transactions: buyers, sellers, third parties and technology, and can be weighted in six dimensions: consumer, institution, information, product, transaction and technology [8].

Table 1.   General theories about e-commerce trust

Class divisions	Subdivisions	representative
Trust-building mechanism	Rational action	Ajzen&Fishbein,1975 [9]; McKinght, 1998 [10]; Bhattacherjee, 2002 [11]; A.F.Salam, 2005 [12]
	Perceived risk [13] Perceived benefit	Jarvenpaa &Todd, 1996 [14];Bellmanet.al, 1999. [15]; featherman & Pavlou，2003 [16];
	Dynamic development	Shapiro, 1987 [17] ;Ba Sulin,2001 [18];
Correlative factors	consumers	Tan F.B .& Sutherland,2004[19];Sultan et al, 2002 [20]; Dan J. Kim et al, 2005.
	Information and technology	Urban et al, 2000 [21]; Sultan et al, 2002. Dan J.Kim et al,2005. Ratnasingam[22]
	institution	Dan J.Kim et al, 2005. McKnight & Chervany,2002[23]

Most e-commerce articles, researching on the distinctive characters of the process in the trust production at the moment of transaction actions online, usually choose the word "online trust". However in this article, we

build up a model that the trust, relating directly to the transaction action, is not just generated on-line, but also can be transferred off-line. The word "e-commerce trust" is better than "online trust" to describe the trust generated and transferred both on-line and off-line.

2.3 Computational experiments

Computing the economic behavior in computational experiments provide us a more practical method than performing experiments with actual people (FE Kydland 1996) [24]. Compared with traditional research methods, computational experiment is a more suitable tool for economics in several ways, deriving from lager numerous variables(Kraut et al. 2004) [25]; adding precision to theory, building and identifying, articulating, and testing the underlying logic (Monge and Contractor 2003) [26]; dealing with complex, dynamic, and nonlinear relationships (Carley and Prietula 1994) [27]. In this article, we can see how the computational experiment provides us a suitable and effective way to solve the problem in market scale analyses.

3.   DEVELOPMENT OF A MODEL FOR TRUST IN E-COMMERCE

In this section, we construct a virtual society in which the agent groups and subgroups of buyer and seller are defined. We defined these two groups' interaction rules. Every group members, buyer group or seller group, perform their task under their own rules, including independent action rules and multi-layered interaction rules (e.g., website sellers generate trust in direct- transaction buyers, and direct-transaction buyers transferring their trust to others).The details of their interaction rules for a single step are described respectively in all the variety of possibilities. Thus, how the trust of the group and subgroups develop over the time is explicit shown in the following section.

3.1 Multi-agent virtual society

According to Dan J. Kim, trust is formed through the interaction of four different entities in online transactions: buyers, sellers, third parties and technology. To simplify the model, we set up a model that only buyers and sellers will be taken into consideration, in order to analysis how the market will change by the strength of buyers and sellers themselves in the most general environment. It should be mentioned that during the process of the trust information transferring, each group may generate subgroups, and each of subgroups has some additional action rules compared with the group of one's belonging to. The action rules of the subgroups will be discussed in details in later sections.

Recent literatures shows complex network, (e.g. social network and WWW) is not completely rules nor completely random, but "small world network" [28-29]. Especially, intentional walks produce scale free small worlds.[30] However, our study focuses on finding the emergent property of the e-commerce market scales evolves, depended on the trust building and transferring. It can be made a somewhat simplified assumption that, without loss of generality, every agent walks randomly on large sample study. In this model, we initially establish 50 agents on behalf of consumers in the network, omitting the factor of the cluster effect and specifying each agent walks in the random direction in every step. By the agents repeatedly interacting with each other and changing their behaviors from their interactions, the market scale of this computational model evolves over time, leading to some emergent properties.

In this paper, virtual online society model consists of four main elements: $Z = <S, D, T, A >$. Here, S represents the group of seller, playing the part of trust generator; D represents the group of consumers, playing the part of trust recipients and diffusers; T represents the time of system; A is the set of action choices of the agent. In what follows, we will describe these parameters explicitly.

3.2 Online seller group and subgroup

Online sellers provide products and services heterogeneously, similarly as what has happened in traditional

markets. Corresponding to the quality of heterogeneous products and services, consumers build different levels of trust for online shopping. Accordingly, we set a simplified classification of sellers- "good sellers"(S_g) and "bad sellers"(S_b) respectively. If one consumer encounters or trade with a good seller, i.e. who will provide the excellent products and services, consumer's trust for online shopping will increase, and vice versa. We describe the concept of the online-sellers group with the help of the following equation (1):

$$S = \{S_g, S_b\} = \{S_{g1}, S_{g2}, \ldots, S_{gm}, S_{b1}, S_{b2}, \ldots, S_{bn}\} \tag{1}$$

Here, m is the total number of the good sellers in the online-sellers group, and n is the total number of the bad sellers in the online-sellers group.

3.3 Online consumer group and subgroup

To facilitate the quantitative analysis, this paper defines a variable "trustlevel" (*TL*) to measure the increase and the decrease of trust level. And corresponding to the value of *TL*, consumers group will be divided into three subgroups: (1) trustor D_r ; (2) hesitator D_y ; (3) refuser D_b. It should be noticed that the notion "trustor" is different from the traditional one in the fiduciary investment, which is an individual or organization transferring fiduciary duty to a third party trustee.

In this article, we define " trustor" (D_r) as the subgroup of the consumers who have a quite high *TL,* surpassing some upper critical point of *TL,* and then are willing to take actions to transact online. The subgroup of hesitator (D_y) holds a little lower *TL* compared to trustor, unwilling to take action immediately but waiting and seeing. The subgroup of refuser (D_b) holds a lowest value of *TL*. Although in reality, even some individuals, like D_y or D_b, will occasionally purchase online with small probabilities. Neither D_b nor D_y will have enough for effective consumption. The scale of D_r, which decides the consumption scale of the e-commerce markets, is the key point of our discussion. In this paper, we are trying to find ways to increase the scale of D_r.

We define TL_{Dr} as the threshold value range for D_r , TL_{Dy} for D_y and TL_{Db} for D_b. In the following experiments, we make different threshold size corresponding to different assumptions of the society, which will be discussed in details later. During the movement and interaction, the agent of consumer group will change their *TL*, and by that way, fall into the range of TL_{Dr}, TL_{Dy} or TL_{Db}. Correspondingly, we can subdivide the consumer group into three subgroups:

$$D = \{D_y, \ D_r, \ D_b\} \tag{2}$$

The least requirement of the threshold values for these three subgroups should be satisfied as following:

$$TL_{Db} < TL_{Dy} < TL_{Dr} \tag{3}$$

3.4 Mechanism of agents' behaviors

3.4.1 Coexistence of rational consumption and irrational consumption

At the beginning, an online seller ($S_{encounter}$), as a new face in the network, is not known for consumers. Also, the consumers have neutral opinions about online trading. It should be emphasized that only at the initial moment all the agents in D are D_y. $S_{encounter}$ may be randomly encountered by some consumer agent ($D_{encounter}$). We may take this encounter as an analogue to a transaction between $S_{encounter}$ and $D_{encounter}$. Then, $D_{encounter}$ changes *TL* depending on which subgroup of S he has trade with and spreads the information of being a victim or a beneficiary to other agents of D with some probability.

To be explicit, we explain an example that it is in an optimistic situation of direct transaction. $S_{encounter}$ belongs to the subgroup of S_g.The *TL* of $D_{encounter}$ will be increased by a certain value. The *TL* of $D_{encounter}$ can cumulate every time when he encounters an agent of S_g. Once the *TL* of $D_{encounter}$ surpass the upper threshold of TL_{Dy}, the specific $D_{encounter}$ will turn to be an agent of D_r, who is glad to share his successful experience of online consumption to other agents in D and play the role of propagator of trust. We take this propaganda as an

analogue to indirect transaction experience.

In the situation of indirect transaction, some agent of D_r will encounter the other agents of D, and make them to increase the *TL* by a certain amount (ΔTL) at one time. Similarly to the situation of direct transaction, one agent of D_y turns into D_r, once he has accumulated enough *TL* and surpassed the upper threshold.

In short, we define $\hat{D}_r$ as an event of D_y encountering D_r, $\hat{D}_b$ as an event of D_y encountering D_b, $\hat{S}_g$ as an event of D_y encountering S_g, $\hat{S}_b$ as an event of D_y encountering S_b.

It should be point out that the stages we just assumed have implied a condition, that is: rational consumption and irrational consumption coexist. Examples from reality of irrational purchase exist, e.g. an impulse purchase [31-32].

The sequence of events is presented in Figure 1 below. As it shown, the process can be divided into three stages: (1)pre-purchase,(2) trust building (or distrust building) by direct purchase experience,(3) trust transferring after transaction. The scheme is quite straightforward and all the components have been discussed above.
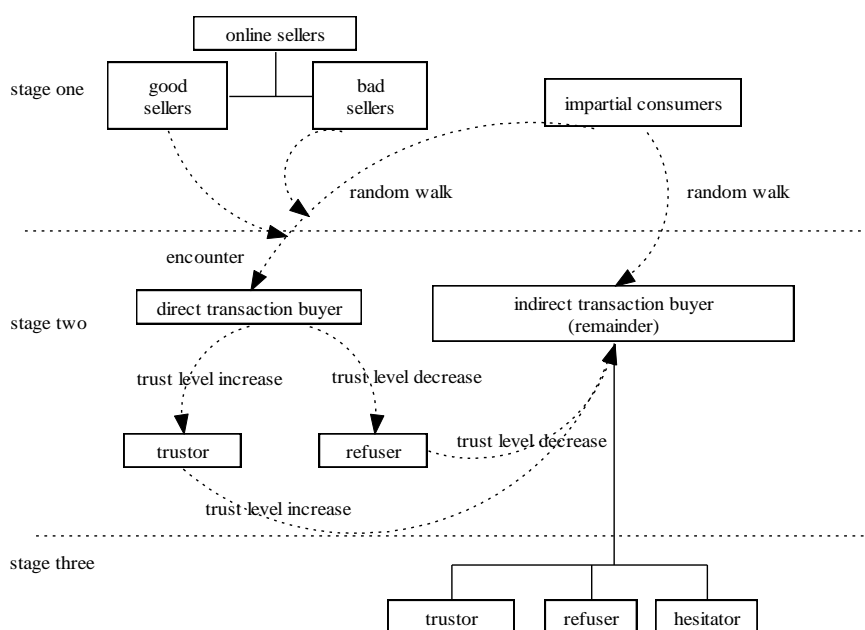

Figure 1. Main stage sequence diagram

3.4.2   Process-based trust stronger than characteristic-based trust

Zucker (1986) provided us three kinds of trust production: process-based, characteristic-based, institutional-based [6]. Noteberg (1999) proved that direct experience, analogue to the process-based experience, can establish a very strong trust [7]. Strub and Priest (1976), Milliman and Fugate (1988) described an extension pattern of trust production that trust can be transferred from another person or group to the trustor who has little or no direct experience [33-34].It is plausible to postulate that trust can be transferred from direct consumers to indirect consumers. But compared with indirect experience related to characteristic-base trust, direct experience related to the process-based trust, will produce much stronger trust (Noteberg, 1999).

3.4.3   Trust determine transaction scale

Although there are few situations of irrational transaction behavior which is not decided on trust [31-32], it will not have a considerable scale to influence the whole e-commerce market. For most part of the consumers, they purchase online only when they have enough trust on e-commerce market. We assume that when *TL* of one consumer is bigger than some critical value, he will be a supporter of e-commerce market definitely. And we

don't care about how high it has exceeded the critical value, but care about how many agents in the set D_r. In brief, we care about the trust-depended variable N_{Dr}, the total numbers of the agents in D_r.

3.4.4 Monotonic transformation to measure the institutional-based trust

The quantity of the level of the institution is difficult to measure. It is necessary to think of a monotonic transformation as a way to measure the level. In the third situation of trust production described by Zucker (1986), trust can be produced by institution. Under the supervision of government or some other third party, it is plausible to postulate that it will be helpful to encourage the honest and high quality businessman, and put an end to the undesirable businessman. Given this interpretation, we define a strictly increasing function $r(\frac{m}{n})$ for which

$$r_g > r_b \to \frac{m_g}{n_g} > \frac{m_b}{n_b} \tag{4}$$

m_b -the total number of the good sellers in the online-sellers group without good institution ;

n_b - the total number of the bad sellers in the online-sellers group without good institution;

m_g - the total number of the good sellers in the online-sellers group in good institution;

n_g, - the total number of the bad sellers in the online-sellers group in good institution.

In this article, we will not discuss the details of the measures of the supervision and regulation on e-commerce market, but use this monotonic transformation to find the relations between institution and market scales.

3.5 General model and parameters

In summary, it is convenient to make a general model by tables. In table 2, we can make a general model to describe the experiment.

Table 2. Groups and homologous parameters

Group (subgroup)	Set	Quantity	Event	TL threshold interval	ΔTL
Seller:	S	$m+n$	-	-	-
(Good seller)	S_g	m	$\hat{S}_g$	-	TLS_g
(Bad seller)	S_b	n	$\hat{S}_b$	-	TLS_b
Buyer	D	N_D	-	-	-
(Trustor)	D_r	N_{Dr}	$\hat{D}_r$	TL_{Dr}	TLD_r
(Refuser)	D_b	N_{Db}	$\hat{D}_b$	TL_{Db}	TLD_b
(Hesitator)	D_y	N_{Dy}	-	TL_{Dy}	0

$T = 0$:

$$TL^i(0) = 0 \qquad (i = 1, 2, ..., N_D)$$

$$N_{Dr} = N_{Db} = 0 \tag{5}$$

$$N_{Dy} = N_D \tag{6}$$

At the beginning, the initial numbers of D_r and D_b are all equal to zeros, and all the agents in the society are hesitators, according to the assumption in Section 3.4.1.

$T > 0$:

$$TL^i(T) = TL^i(T-1) + \Delta TL$$

$$TL_{Dy} = \left\{ TL \mid \underline{TL_{Dy}} \leq TL \leq \overline{TL_{Dy}} \right\} = \left[\underline{TL_{Dy}}, \overline{TL_{Dy}} \right] \tag{7}$$

$$TL_{Db} = \left(-\infty, \underline{TL_{Dy}}\right) \qquad (8)$$

$$TL_{Dr} = \left(\overline{TL_{Dy}}, +\infty\right) \qquad (9)$$

Here, $TL^i(T)$ is the trust level (*TL*) of the agent *i at time T*. ΔTL is the change of the *TL* from time *T-1* to time T. $\underline{TL_{Dy}}$, $\overline{TL_{Dy}}$ is the lower threshold of the set D_y and the upper threshold of the set *D* respectively.

Now we will discuss ΔTL. Based on the assumption in section 3.4.2,process-based trust stronger than characteristic-based trust, we may argue that the values of ΔTL in the encountering event of $\hat{S}_g$ and $\hat{S}_b$ is much lager than those in the encountering events of $\hat{D}_b$, $\hat{D}_r$ .Furthermore, once the agent in *D* has a positive or negative opinion based on solid processes ,i.e. direct transaction experience, they will easily change their opinions by other's   recommendation in the market. Thus we will have the function (10) as following:

$$\Delta TL = \begin{cases} TLS_g & \hat{S}_g \\ TLD_r & TL(T-1) \in TL_{Dy} and \hat{D}_r \\ 0 & other \\ TLD_b & TL(T-1) \in TL_{Dy} and \hat{D}_b \\ TLS_b & \hat{S}_b \end{cases} \qquad (10)$$

And the function (11) should be satisfied:

$$TLS_g > TLD_r > 0 > TLD_b \qquad (11)$$

4.   COMPUTATIONAL EXPERIMENTS AND OUTCOMES

We performed three kinds of experiments with the model, which produces trust by the explicit interactions between the group of sellers and buyers, and within the group of buyers. We are mainly interested in how changes in market scale based on different kind of trust strategies. All these strategies have been discussed earlier.

All the model experiments presented in this paper were performed in NETLogo. Each experiment was performed 1000 times to check the robustness of the simulated results against random effects and each experiment has run 20000 steps to examine the stability. A brief summary of each experiment is presented in Table 3. Those parameters that were varied between the three experiments are listed in Table 4. The setups and objectives of each experiment are discussed in details in the subsections.

Table 3.   Situations of three experiments

Experiment	Situation
Exp1	Buyers are risk-aversion and market is without good institutions
Exp2	Buyers are risk-neutral and market is without good institutions
Exp3	Buyers are risk-aversion and market is with a good institutions

Table 4.   Values of parameters changed in the experiments

Set	S	S_g	S_b	D	D_r		D_b		D_y
parameters	m/n	TLS_g	TLS_b	N_D	TLD_r	TL_{Dr}	TLD_b	TL_{Db}	TL_{Dy}
Exp1	1	20	-20	50	5	$(10,+\infty)$	-10	$(-\infty,0)$	$[0,10]$
Exp2	1	20	-20	50	5	$(5,+\infty)$	-5	$(-\infty,-5)$	$[-5,+5]$
Exp3	2	20	-20	50	5	$(10,+\infty)$	-10	$(-\infty,0)$	$[0,10]$

4.1   Experiment 1

We setup a model of a risk-aversion society, as a baseline for further comparisons. Figure 2 shows the initial moment. The rings stand for the seller, and the color of the rings shows that they are in the red for the good seller, or in black for the bad seller respectively. The ratio of red to black is equal to *m/ n*. The symbols of

body forms are the buyer agents, who walk randomly in the land. Here, we define the color of the buyer agents, yellow for hesitators, red for trustors and black for refusors. Figure 3 shows the ultimate situation after 20000 steps. The numbers besides the buyer agents show the value of *TL*.

We are interested in the trend of market scales, in which the expected value and deviation are the most important issues. Figure 4 shows the change process of the mean of N_{Dr} in red dot dash line, N_{Db} in the black solid line, N_{Dy} in yellow dotted line. Figure 5 shows the N_{Dr} in histogram. We slice the process into three stages, and then Figure 5 tells us the changes of the deviation of N_{Dr} using the cross sectional data.
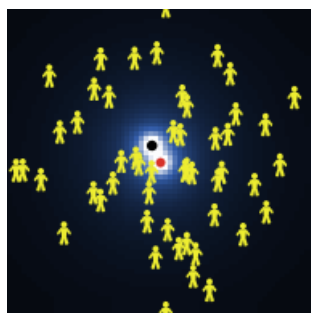

Figure 2. Initial Situation

Figure 3. Ultimate Situation

As we all known, most buyers are risk-aversion in reality. They will take conservative steps to the online market, which gives us a rather higher threshold value TL_{Dy} for purchase action. Furthermore, their trusts are more vulnerable once they heard of some negative news. That is to say, the change of the trust level by positive news (TLD_r) is smaller than that by the negative news (TLD_b).According to this principles, some assumption value are shown in Table 4.

Since this is a risk-aversion society, trust is so hard to build and so easy to disrupt. It sounds reasonable to construct a hypothesis that N_{Db} has an upward trend in the whole process.

However, the result is not the case. Figure 4 displays clearly the upward trend over certain time periods. The number of refusors N_{Db} goes quickly upward and then at about the 3000 step, it turns downward. And it is surprising to find that the number of trustor N_{Dr} keeps a very slow increase and then go to an equilibrium stage. Figure 5 shows that the deviation of N_{Dr} keeps growing. As we have point out the number of trustors represents the effective purchasing power, we may interpret that volatility of market scale can go decreasing in the risk-neutral society. That is to say the market is more and more volatile, at which we are not satisfied. Now, we get some important findings by Experiment 1.Those are:

Finding One - Even in a risk-aversion society, the trustors of the market can still take some small part in the market.

Finding Two - In a risk-aversion society, volatility of the expected value of market scale keeps going up as time passes.
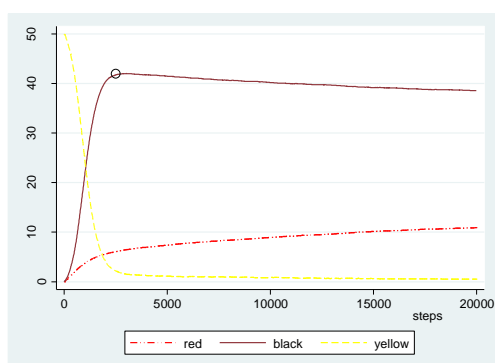

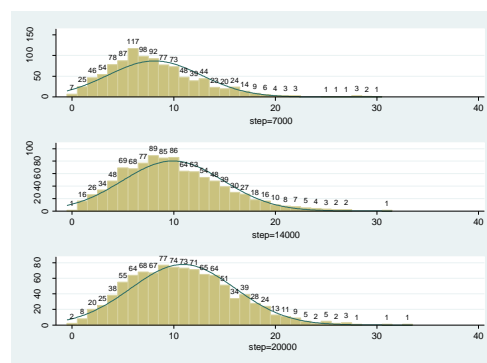**Figure 4.   Average Number Changes (Experiment 1)**

Figure 5. N_{Dr} in Histogram (Experiment 1)

4.2 Experiment 2

In the previous experiment, we assumed a risk-aversion society. We know from the literature study that we may change the factor of the character of consumers, and let them easily to build trust on online traders. In this experiment, we build a risk-neutral society based on the character-based trust by Zucker(1986) .

Since the buyer agents are all risk neutral, the expectation of the utility of buying and not buying are equal, that is to say the threshold point TL_{Dy} for buying and not buying are symmetrical. The change of the trust level by positive news (TLD_r) is equal to that by the negative news (TLD_b).

Up till now, we have explained how to build a risk-neutral society. Theoretically, in this experiment, we try to find out the influence of the characteristic-based trust on the market scale, by changing only the factors related to the characters and holding all other factors fixed.

As it shown in Figure 6, both the numbers of trustors and the refusors keep synchronous increasing until it reaches an equilibrium point(near the 4000 steps). The derivation of the number of trustors keeps dwindling. It is maybe a satisfactory idea to build a risk-neutral society, in order to make the market scale going steady. However, the fact that only 50% of the population remain refuse to the e-commerce market is frustrating. Now we get another two important findings. Those are:

Finding Three- The factor of the character of consumers influences on the equilibrium size of the market.

Finding Four-In risk-neutral society, the market goes self-stable as time passes.
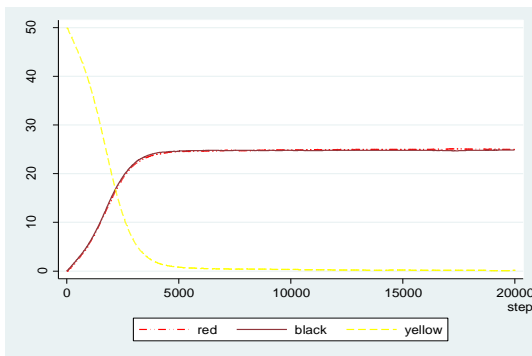

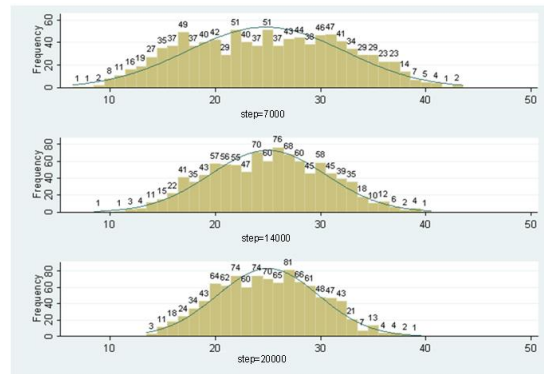Figure 6. Average Number Changes (Experiment 2)

Figure 7. N_{Dr} in Histogram   (Experiment 2)

4.3   Experiment 3 and outcomes

Our object is to find an effective way to get a stable and keep-growing market for online market. We look at Experiment 1 as a benchmark and try to find factors affecting the expected value of the market scale.

As the previous experiment shown, when we change the character of consumers, the equilibrium size of the market will change. But is it an effective way? According to Zucker (1986), we can find another way to build trust in the market, which is called institutional-based trust. As we have discussed in section 3.4.4, we use a monotonic transformation to measure the institutional-based trust, that is $\frac{m}{n}$. In this experiment, we change the ratio to 2, holding all the other factors to be same as Experiment 1(as shown in Table 4).

Figure 8 displays the change of average number in the whole process. It is interesting to find, similar to Experiment 2, that at about the 3000 step the refusors N_{Db} turns downward with a much sharp slope. And N_{Dr} keeps growth, and near the 10000 step N_{Dr} surpasses N_{Db} , which is shown as the triangle point in the Figure 8. It is encouraging to find that the number of trustors keeps increasing and gradually become an overwhelming majority of the market. Figure 9 shows the deviation of N_{Dr} keeps dwindling in the process. That is to say the stability of the market scale is increasing. Compared with Experiment 1 and Experiment 2, it is

more satisfactory to construct a self –stable and self-growing market, which is:

Finding Five – The factor of institution can change the market effectively. Even in a risk-aversion society, better institutions can make the market self-stable and self-growing.
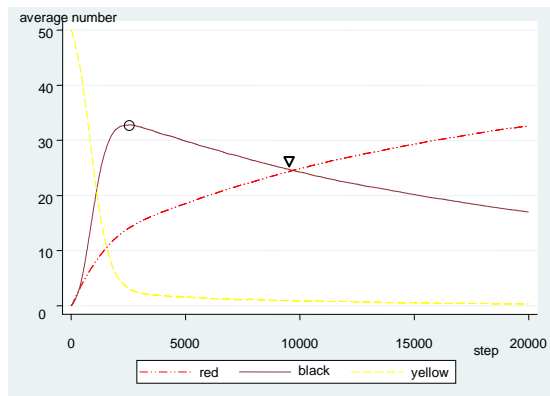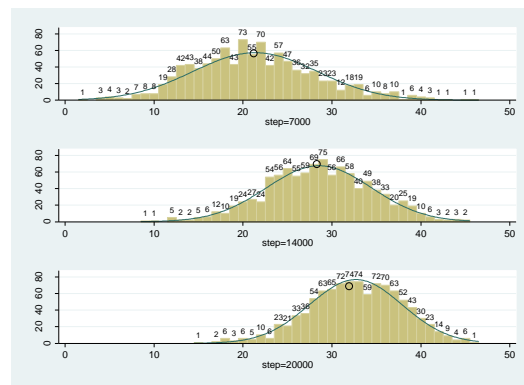

Figure 8. Average Number Changes (Experiment 3)

Figure 9. N_{Dr} in Histogram (Experiment 3)

4.4 Comparisons and conclusions

In Tables 5, we examined statistical properties of N_{Dr} at the 35, 70, 100 percent level of duration, corresponding to the 7000, 14000, 20000step respectively, as a comparison on these three experiments.

Table 5. Comparison of statistical properties of N_{Dr} in three kinds of models

Exp NO.	Exp1			Exp2			Exp3		
Percent of duration	35%	70%	100%	35%	70%	100%	35%	70%	100%
Mean	8.12	9.92	10.91	24.79	24.99	25.0	21.36	28.54	32.68
Std. Dev.	4.60	4.96	5.13	7.43	5.49	4.80	7.00	5.90	5.19
Skewness	1.123	0.66	0.53	0.02	0.01	0.08	0.40	-0.89	-0.25
Kurtosis	5.28	3.45	3.33	2.12	2.46	2.43	3.19	2.95	2.97

By the comparison, Experiment Three provides a better solution to increase the market size. The highest mean value of N_{Dr} tells us that, even in a risk-aversion society, good institution will effectively increase the market size. Additionally, decreasing vibrations show the increasing stability of the market size.

5. CONCLUSIONS

In this article, we designed three computational experiments by stimulating the situation of building and transferring process in the market. We can compare three kinds of society: the risk-neutral without institution, risk-aversion without institution, risk-aversion but with good institution. And it is interesting to find that risk-aversion character will increase the volatility of market as time develops. And risk-neutral character can only change the balance size of the market. It is constructive to find that in a risk-aversion but good institutional society can produce market which has a highly upward trend and can be self-stable. Therefore, we can make a conclusion here that we need to enforce and improve the institution of the online market, for which is the best way to protect the market to keep a ceaseless growth and being self -stable.

There are some limitations to this study. Firstly, since the trust formation process is difficult to observe and measure, we can only utilized practitioners' and academics' conceptual models of trust building and transferring. There may be some details which may not support the actual nature of the trust formation process from a consumer's perspective. And secondly, we can only examine the institution by using an intuitively monotonic transformation, for the lack of the literature to proof.

Nevertheless, this study offers some meaningful contributions. Firstly, on academic point, the current research proposes a way to investigate the market scale based on trust building and transferring on time variant process. This interactive process based on multi-agent models can be a new way to discuss the market scales in a dynamic way. Secondly, the results are practical that they can encourage e-commerce regulatory agencies to take more effective ways to increase the market size and decrease volatility of the market, which is beneficial to the whole society, both the buyers and sellers.

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