System dynamics simulation model for the electronic commerce credit risk mechanism research

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Abstract

The credit system is not perfect in E-commerce; lead to a lot of credit risk in E-commerce transaction, the rapid development of electronic commerce was been restrained. Application of system dynamics theory and the computer simulation, it has carried on the modeling of electronic commerce credit system composition, forming factors and the relationship. It carries on the quantitative analysis of the key factor for the formation of credit risk to the electronic commerce. Find out the effect of various factors on the credit risk, and from the perspective of system in e-commerce credit system provides theory basis for improvement.

Keywords: *System dynamics, E-commerce, credit risk, credit system, simulation.*

1. Introduction

With the development of Internet technology and the increasing popularity of information technology, E-commerce becomes a mark of the information society and the economic globalization. With the rapid development of electronic commerce, online trading of credit crisis also appears day by day, the false trading and online fraud and infringe upon the rights of consumers, etc. Various kinds of discreditable behavior often happen, Internet users on the Internet in E-commerce credibility is not high, influence restricting the development of e-commerce [1][17] .

In order to ensure that electronic commerce in the healthy development of the Internet, enhance the Internet users online trading credibility [2][16].About E-commerce credit problems research, mainly focused on the establishment of credit evaluation model and the improvement of the credit system, which obtained a certain research achievements. However, about the E-commerce credit risk formation mechanism and electronic business credit risk factors analysis research are relatively less [15].

In view of various factors about the electronic commerce credit risk formation, by use of the system dynamics research method and mathematical model analysis, the scientific explanation E-commerce credit risk reasons, and provide theoretical basis for the rationalization suggestion about E-commerce credit the evasion of the risks.

2. System dynamics and VENSIM of software

System dynamics (SD) is a theory of system structure and an approach for representing such a complex system and analyzing its dynamic behavior [3][4],comparing to the traditional methods, the SD simulation approach studies the dynamic evolving ,cause-effect, interrelations and information feedbacks that direct interactions in system overtime, and it is does not require longitudinal data. The use of computer simulation software to simulate the different strategies, and achieve the behavior of the system, and help researchers to understand the dynamic behavior of a system for structural reasons, to analyze and design a dynamic complex problem solving and improve system performance [13][14].

VENSIM software is system dynamic simulation software, by American Lentanna System company development. This software is relatively user friendly and traffic safety; researchers should not have major difficulties in learning the tool. By providing a causal loop and flow chart and other related models, realized quantitative relation between the variables and parameters, and understand the feedback variables in a system, and the relationship between input and output.[3][4][7][8].

3. E-commerce credit risk analysis

Credit is an important aspect of E-commerce, and understanding its antecedents and consequences is a prime concern for following reasons. First, the antecedents of credit enable us to know the relative importance of factors affecting trust, understanding these factors would play and important role devising appropriate means to facilitate credit. Second, the consequences of credit would enable us to better understand the importance of credit and effect on E-commerce [18].

3.1 E-commerce credit risk

In E-commerce research, credit is related to competence, responsibility, dependability, likeability, and honesty [16]. It helps consumers overcome perceptions of uncertainty in online transactions in E-commerce. In E-commerce, credit can be defined as consumers believe that a particular transaction in a manner consistent with their own expected subjective probability, to the electronic commerce credit awareness and the improvement will be beneficial to the extended of E-commerce [3].

However to improve and enhance the electronic commerce credit, it is the key to cognitive the electronic commerce credit risk, E-commerce credit risk refers to credit ability about the electronic business activities or virtual market transaction subject, and uncertain about the transaction subject abide by market contract degree of uncertainty,. Improve the E-commerce credit risk, the principal transactions and related factors of understanding, can be reduced the uncertainty about E-commerce credit risk.

3.2 E-commerce credit risk factors [9]

Through of understand the electronic commerce credit risk, we know that the E-commerce credit risk are a multi-factorial, complex and nonlinear system, its credit risk mainly consists of two factors, including static factors and dynamic factors. These factors are shown in Fig 1:
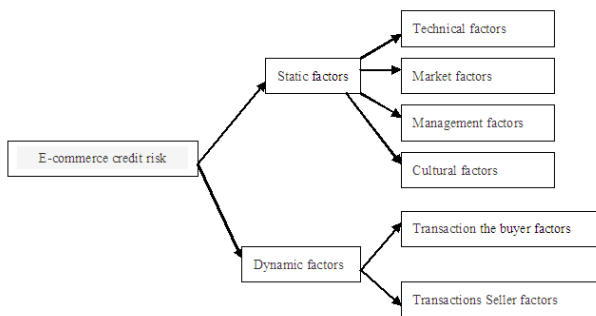

Figure 1: diagram of E-commerce credit risk factors

Table 1: static factors table

Static factors	Instruction
E-commerce technology factors	It was referred to computer and communications encryption technology in E-commerce transaction network, technical factors impacted on E-commerce credit risk, it was shown that loss of information and technical defects or password cracking.
E-commerce management factors	It was referred to trading both management procedures and management systems in E-commerce transactions, management factors impact on E-commerce credit risk, it was mainly shown poor management caused by acts of dishonesty in transactions.
E-commerce market factors	It was referred to the structure of market information and the degree of the market and market factors affect E-commerce credit risk, it was mainly shown the parties lead to imperfect level of E-commerce market about the transaction trading platform.
E-commerce and social factors	It was referred to the degree of social awareness and the degree of credit risk in E-commerce transactions; it was mainly shown social constraints and the impact in E-commerce transactions.

Table 2: dynamic factors table

Dynamic factors	Instruction
E-commerce transactions Seller factors	It was referred to the purchasers of credit services, the level of the quality of the goods, the level of commodity prices and trading credit score in E-commerce transactions. When the implementation of the dynamic behavior of the purchaser's credit is higher, dynamic risk will be reducing. When the implementation of the dynamic behavior of the purchaser's credit is lower, dynamic risk will be increasing.
E-commerce transactions buyer factors	It was referred to the bargainer's level of education, risk awareness, the deceived number of times and the experience of being cheated in E-commerce transactions. The buyer of factors affect the performance of E-commerce credit risk, When the implementation of the dynamic behavior of the bargainer's credit is higher, transaction risk will be reducing. When the implementation of the dynamic behavior of the bargainer's credit is lower, dynamic risk will be increasing.

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35

Static factors were referred to basic role in E-commerce credit risk formation, its objectivity is very strong, and its subjectivity is weak factors, including E-commerce electronic technical factors, E- commerce management factors, E-commerce market factors and E-commerce electronic social factors. Instructions are given in table 1:

Dynamic factor were referred to a dynamic role in E-commerce credit risk form, its subjectivity is strong, its objectivity is weak and such bargainer's factor, and the purchaser's factors etc. its instructions are given in table 2:

4. The electronic commerce credit risk model based on the system dynamics

Through analysis to the electronic commerce credit risk factor, by use of system dynamics modeling, respectively in view of the electronic commerce credit risk factors, including static factors and dynamic factors , these were be designed. Because of the static factors belong to fundamental effect, when electronic commerce transaction was formed, technical factors, management factors, market factors and cultural factors have been identified, so these factors can be considered fixed constant factors, as long as the social environment change, the influence of these factors are constant, in order to better describe the dynamic factors and static factors in electronic commerce credit risk system, it was main thought dynamic factor changes impact on credit risk in the main feedback loop, and the quantitative analysis was be done by use of causality diagram and system flow chart [10][11].

4.1 electronic commerce credit risk formation causal graph

Causal loop diagram is important tool, it was represent system feedback structure, it can rapidly express system dynamic formation reason, through analysis to the electronic commerce credit risk factor, E-commerce credit risk causal diagram can be created, the system feedback structure are given in fig2:
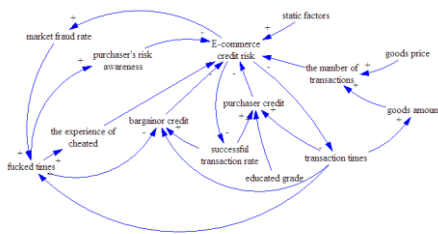

Figure 2: E-commerce credit risk form a causal relationship

In figure 2, the arrow side with "+" means positive feedback, variable increases (decrease) will cause another variable associated increase (decrease). In the arrow side with "-"means degenerative feedback, variable increase (decrease) can cause associated another variable decrease (increase) [4] [12] [13].

From figure 2, E-commerce credit risk is mainly affected by static and dynamic two kinds of factors, the dynamic factors including bargainers credit and the purchasers credit and trade amount and the buyer risk awareness and deceived experience factors on the E-commerce credit risk factors, these were shown negative feedback, at the same time trades and successful trading rate was be shown negative feedback, and to market fraud rate was be shown positive feedback.

4.2 The electronic commerce credit risk formation system flow model

Causal diagram based on the use the system dynamics modeling and by use of VENSIM of simulation software. It was being build to E-commerce credit risk system flow diagram; the system flow model is given in Figure 3:

In figure 3, E-commerce credit risk was be means the amount of system state, and accumulation of the results about E-commerce credit risk change, was be shown by use of rectangular. The E-commerce credit risk rate was be shown the reason of its changes about state variable, and can be divided into inflow rate variable and outflow rate variable, were be shown the engineering drawing of valves. "Cloud" symbol system boundary.
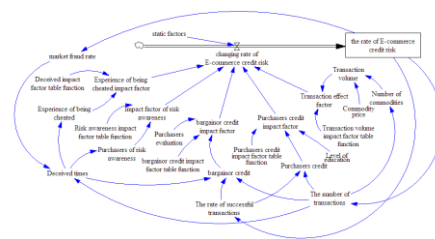

Figure 3: E-commerce credit risk of the formation of a system flow diagram

From figure 3, we can see that the static factors and dynamic factors including deceived experience, risk awareness, the purchasers and the bargainers credit have influence to turnover of electronic commerce credit risk, in order to be able to show between the relationship the dynamic factors and electronic business credit risk rate

cheated experiences influence factor, risk awareness influence factor, the purchasers and the bargainers credit impact factor influence factor and turnover influence factor have been used. By using of table function, realize the relationship between dynamic effect factor and E-commerce credit risk rate of change.

In VENSIM software, table function is a function type in system dynamics, particularly suitable for described the nonlinear relationship between two variables, usually variable value was be done by using linear interpolation method in this study model, the five table function were be used, including deceived experiences influence factor table function and risk awareness impact factor table function and the purchaser credit impact factor table function and the bargainer credit impact factor table function and turnover impact factor table function.

In the construction of E-commerce credit risk system data flow diagram was be built, According to E-commerce transaction process credit risk which involves various factors, E-commerce credit risk formation mechanism was be quantification, and the dynamic equation of E-commerce credit risk was built, the equation is given in (1)

$$\frac{dE(t)}{dt} = CH(t) + R(t) + P(t) + B(t) + C(t) + ST \qquad (1)$$

Where E(t) is change rate of risk, CH(t) is change rate of cheated, R(t) is change rate of risk awareness, C(t) is transaction volume, P(t) is change rate of purchaser's credit, B(t) is change rate of bargainer's credit, ST is static factors constant.

5 Simulation and results analysis

5.1 Electronic Commerce Credit Risk Forming Simulation based on dynamic factors

In order to verify the accuracy of the E-commerce credit risk modeling, and understand a causal relationship between the various factors and their interaction in E-commerce credit risk, The system was be simulated by use of three factors including market fraud rate and the purchasers the three factors of the credit and the buyer by the level of education system simulation analysis.

1. The simulation analysis about changes of market fraud rate factors

To illustrate changes of the market fraud rate impact on the credit risk of E-commerce, the four different market fraud
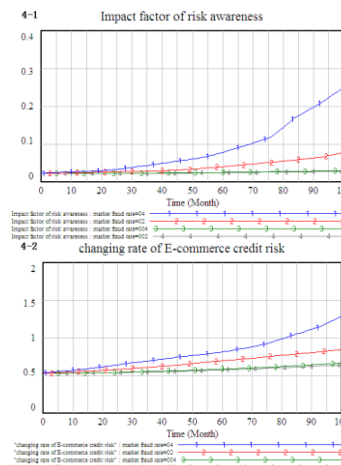
rate value were be selected as the simulation analysis, the value of market fraud rate are 0.4,0.2,0.04,0.02.

(1) It can be seen from Figure 4-1, when the market fraud rate is lower, the buyer also lower risk awareness, when market fraud rate rises, the bargainers risk awareness. When market fraud rate rises, the market environment of E-commerce was be deteriorated, buyer awareness were be enhance in E-commerce transactions, and the insecurity of the market will result in the purchaser's awareness enhanced.

(2) It can be seen from Figure 4-2, when the market lower fraud rate, E-commerce credit risk was smaller, market fraud rate rises, and the credit risk of E-commerce will be high. This market fraud rate will affect the E-commerce credit risk, so inhibiting market fraud rate, it is to key factor ensure health of E-commerce market credit system.

(3) It can be seen from Figure 4-3, when the market fraud rate is lower, the purchasers credit have a less change, when market fraud rate rises, the purchasers credit will have a larger change, it was indicated the purchasers of credit depends on the E-commerce market environment in E-commerce transactions, the environment was be worse, the purchasers credit will be lower.

(4) It can be seen from Figure 4-4,the level of market fraud rate is the same as the bargainers credit, which is also can be seen that the asymmetry in the E-commerce market transactions, the purchasers is the master of the transaction, the buyer is not master of transaction.

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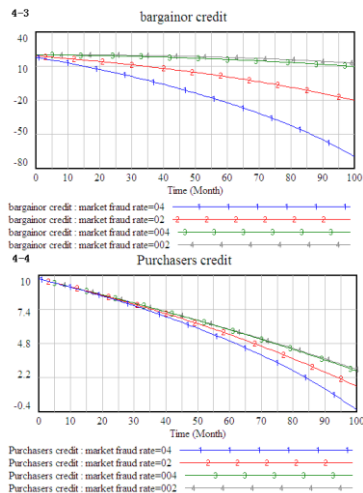ISSN (Print): 1694-0814 | ISSN (Online): 1694-0784
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37

Figure 4: E-commerce credit risk simulation diagram form - market fraud rate factors change

2. Simulation analysis about purchaser's credit factors change

To illustrate the purchasers credit changes impact of E-commerce credit risk, select three different the purchasers credit values, it was analysis in system simulation, the values of credit are 40,30,20, higher values indicate an initial credit of purchasers transactions is higher.

(1) It can be seen from Figure 5-1, the credit of the purchasers is higher, and E-commerce credit risk is lower, purchasers credit is lower, E-commerce is the higher, so E-commerce credit risk depends on the purchasers credit, strengthen E-commerce management and business transactions constraints purchasers will reduce the risk of E-commerce credit.

(2) It can be seen from Figure 5-2, the purchaser credit is lower, market fraud rate is higher, strengthen supervision will reduce the occurrence of fraud in E-commerce transactions in the market.

(3) It can be seen from Figure 5-3, purchaser credit is higher, bargainer awareness is low, and purchaser credit is lower, bargainer awareness is high. The purchasers' credit direct contact and determine the level of buyer risk awareness in E-commerce transactions.

(4) It can be seen from Figure 5-4, the high credit of the purchasers, the bargainer's credit is high, low credit of the purchasers, the bargainer's credit is also low. As can be seen, the purchaser's credit is high, the buyer less chance of being cheated, the buyer credit will increase, but when the purchasers credit is low, the buyer who might suffer further increase the risks of trading, could lead to returns and no

trading after the transaction,, resulting in the bargainers credit to reduce in E-commerce transactions.
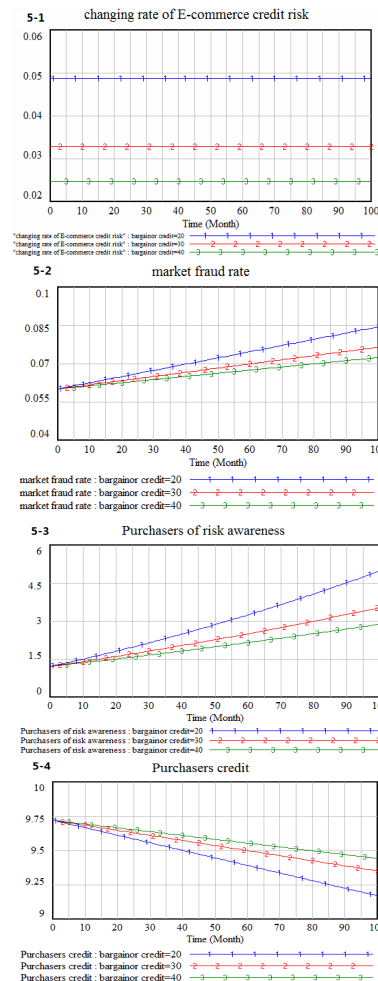

Figure 5: E-commerce credit risk form - the purchasers of credit factors change simulation Figure

3. Simulation analysis about bargainer education level factors change

To illustrate the educational purchaser impact of E-commerce credit risk, select three different values to analysis different level of education, values of the level of education are 5, 10, 20, and higher values represent the degree of buyer education higher.

(1)It can be seen from Figure 6-1, the buyer is the low level of education, E-commerce credit risk is high, and the buyer is the high level of education, E-commerce credit risk is low. The bargainers has high level of education, it can be acceptance new technology and new knowledge, the misuse few transactions hasn't happen in the transaction

process, to improve understanding of E-commerce in credit risk and also reduce the risk of the transaction.

(2) It can be seen from Figure 6-2, when the bargainers level of education is high, the fraud rate will be reduced in the market. From executable buyer transactions in E-commerce transactions, the level of education is high, the occurrence of the fraudulent behavior may be given to reduce in the market, the market environment will be better.

(3) It can be seen from Figure 6-3, when the bargainers level of education is high, the number of deceived will be reduced, to master new technologies and knowledge of E-commerce transactions, buyer can effectively recognize fraud in E-commerce transactions, and to reduce the number of deceived.

(4) It can be seen from Figure 6-4, an interesting phenomenon, the bargainer's level of education is high, transaction volume is low, the bargainer's level of education is higher, and the transactions volume is low. When bargainers have a high level of education, they will attention to the goods quality and bargainer's credit, and E-commerce operating environment, they will more cautions in buying goods, so it will affect the volume of transactions. When bargainers have a low level of education, they will ignore the goods quality and bargainer's credit; they will be influence by the bargainer's publicity, so it will increase value of transactions.
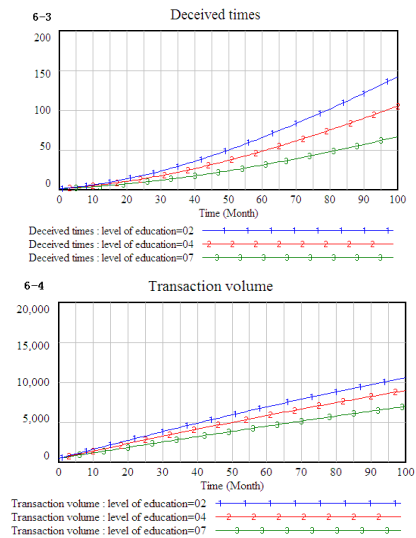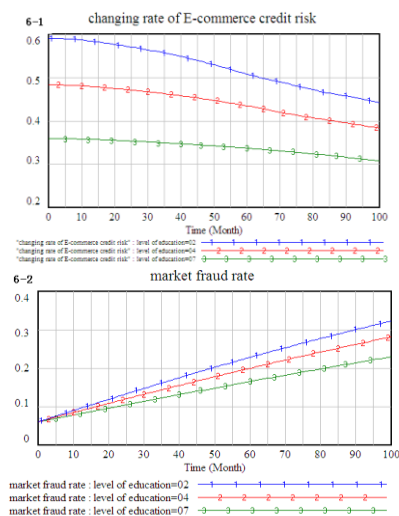
Figure 6: electronic commerce credit risk formation -- the buyer education factors simulation diagram

6 Conclusions

The causal relationship of the factors and feedback relationship were analyzed in E-commerce credit risk of formation by theory. E-commerce credit risk of the formation of the model was be built by the simulation analysis of the different factors and different parameters of the system, the E-commerce credit risk the formation dependent on dynamic factors and static factors and the dynamic purchasers credit factors, and market fraud rate ,and the buyer by the level of education may decrease or increase the risk of E-commerce credit, and therefore should be strengthened, the E-commerce credit risk mechanism construction supervision in E-commerce transactions, improve the trading system to reduce market fraud ,at the same time improve the purchasers credit review and improve the integrity of the purchasers in E-commerce transactions, and improve knowledge of E-commerce transactions advocacy training ,and improve The bargainers level of education, which can effectively reduce the risk of E-commerce credit, and enhance the correct decisions of the E-commerce manager, it has provide a theoretical basis.

The interesting phenomenon is appeared in the simulation, when the level of education is high, transaction amount decreases, although have made explain, how to use mathematical model to explain this phenomenon, it will be follow-up work in the research.

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39

Appendix

Summary of the information of the system parameters and expressions:

(01) bargainer credit=20 + The number of transactions*The rate of successful transactions*0.01-Deceived times *0.3

(02) bargainer credit impact factor=bargainer credit impact factor table function(bargainer credit)+20

(03)bargainer credit impact factor table function([(-350,0)-(-50,1)],(-342.661,0.97807),(-285.168,0.916667),(-272.936,0.885965),(-238.685,0.763158),(-216.667,0.635965),(-188.532,0.47807),(-166.514,0.346491),(-122.477,0.214912),(-89.4495,0.118421),(-47.8593,0.0833333),(-9.93884,0.0745614),(38.9908,0.0482456),(48.7768,0.00877193))

(04)"changing rate of E-commerce credit risk"=1/(Purchasers credit impact factor + Transaction effect factor+ bargainer credit impact factor + Experience of being cheated impact factor + static factors +Impact factor of risk awareness)

(05)Commodity price=20

(06)Deceived impact factor table function ([(0,0)-(300,1)],(1.22324,0.00438596),(22.0183,0.0219298),(31.8043,0.0570175),(47.0948,0.122807),(62.9969,0.166667),(83.792,0.201754),(111.315,0.285088),(130.275,0.337719),(149.847,0.425439),(162.691,0.517544),(186.239,0.609649),(205.505,0.688596),(238.532,0.828947),(297.248,0.982456))

(07)Deceived times=The number of transactions*market fraud rate

(08)Experience of being cheated=20+Deceived times *0.4

(09)Experience of being cheated impact factor=Deceived impact factor table function (Experience of being cheated)

(10)FINAL TIME = 100
Units: Month
The final time for the simulation.

(11)Impact factor of risk awareness=Risk awareness impact factor table function (Purchasers of risk awareness)

(12)INITIAL TIME = 0
Units: Month
The initial time for the simulation.

(13)Level of education=0.2

(14)market fraud rate= INTEG ("changing rate of E-commerce credit risk"/1000*5,0.06)

(15)Number of commodities=the number of transactions*1.2

(16)Purchasers credit=10-The rate of successful transactions*The number of transactions*0.02

(17)Purchasers credit impact factor=Purchasers credit impact factor table function(Purchasers credit)+Level of education

(18)Purchasers credit impact factor table function([(10,0)-(20,1)],(10.0612,0.0131579),(10.7645,0.0350877),(12.1713,0.0570175),(13.2416,0.0789474),(14.0673,0.118421),(15.2599,0.179825),(16.5749,0.359649),(17.0642,0.482456),(17.5841,0.609649),(18.104,0.697368),(18.9908,0.789474),(19.5413,0.903509),(19.8471,0.991228))

(19)Purchasers of risk awareness=Deceived times

(20)Risk awareness impact factor table function([(0,0)-(600,1)],(3.66972,0.0219298),(51.3761,0.0307018),(100.917,0.0526316),(132.11,0.0657895),(203.67,0.118421),(233.028,0.166667),(332.11,0.267544),(379.817,0.421053),(420.183,0.526316),(466.055,0.618421),(508.257,0.679825),(554.128,0.846491),(574.312,0.947368),(596.33,0.986842))

(21)SAVEPER = TIME STEP
Units: Month [0,?]
The frequency with which output is stored.

(22)static factors=0.2

(23)The number of transactions= INTEG ("changing rate of E-commerce credit risk"*8,20)

(24)The rate of successful transactions= INTEG ("changing rate of E-commerce credit risk"/1000,0.7)

(25)TIME STEP = 1
Units: Month [0,?]
The time step for the simulation.

(26)Transaction effect factor=
Transaction volume impact factor table function(Transaction volume)

(27)Transaction volume=Number of commodities*Commodity price

(28)Transaction volume impact factor table function([(0,0)-(90000,1)],(733.945,0.0131579),(5137.61,0.0307018),(9724.77,0.0570175),(11926.6,0.0745614),(14862.4,0.100877),(17981.7,0.135965),(20733.9,0.162281),(23853.2,0.184211),(29174.3,0.223684),(36880.7,0.280702),(41834.9,0.324561),(44587.2,0.381579),(47614.7,0.438596),(52477.1,0.552632),(57798.2,0.640351),(61651.4,0.710526),(64678.9,0.745614),(72385.3,0.850877),(89449.5,0.986842))

Acknowledgments

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