ICST Transactions
on e-Business
Research Article ICST.ORG

An improved model of virtual-currency in social networking sites

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Abstract

Virtual-currency has become an important service and brought a great profit to SNS companies in China. In this paper, based on some economic theory and algorithms, we systematically analyze the operation mechanisms of the virtual-currency in China. Three models, the ideal model, the actual model and the improved model are given to illustrate how virtual-currency services bring profit to SNS service suppliers. Moreover, in the improved model we propose a novel withdrawal mechanism: unlike the other two models, the improved model allows the users using virtual money to buy real goods. This mechanism can bring more profit to the SNS companies. A survey among 859 SNS users of mainland in China is conducted to evaluate the feasibility of our proposed model. The results of the survey showed that SNS companies should consider the additional mechanism for users to exchange real goods with virtual-currency, a win-win situation for all parties in SNS development.

Keywords: Virtual-currency, money exchange, social network, webcoin

Received on 25 November 2012; accepted on 31 March 2012; published on 05 September 2012

doi: 10.4108/eb.2012.07-09.e3

1. Introduction

In recent time, social networking sites (SNS)(N.B. Ellison & Boyd, 2007) have become an indispensable part of our lives. The communication and interaction among individuals is ever-becoming an impact due to the rapid development of SNS (Farmer, Bruckner Holt, Cook, & Hearing, 2009): SNS such as Facebook, Twitter, and MySpace in the United States of America (USA) and Europe; and Renren, QQ, and Weibo.com in mainland of China attract millions of people. People log into their different SNS accounts every day to communicate with friends on the Internet to exchange news, share interests and opinions and upload their photos, and in some social circles regard visiting SNS as a daily routine. Naturally, it is no wonder that SNS is also becoming a hot research topic both on social science and computer domains (Ho, 2011; Shakimov et al., 2011). Many researchers from different areas focus their research upon different aspects of SNS.

Since China's SNS market contains the largest consumer group of the world(Zimmermann, 2011), the investigation on the development and operation of SNS in China has a great impact to the advancement of SNS in the world. Among those studies, Nicole B. Ellison and his team took China's QQ.com as a case to study the development trend of SNS(Nicole B. Ellison, Lampe, & Steinfield, 2009); Patricia G. Lange's research focused on the public video-sharing services in SNS in China(Lange, 2007). China's own researchers also show great interest on the study of China's SNS conditions, Zeng and Liu

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tried to analyze the influences of SNS to people's communication in China(Xue & JingWei, 2011); Lin's work made a comparison between SNS in China and the USA and find that there are some differences in source sharing, user age range and men-to-women ratio between SNS in China and SNS in the USA. (Lin, 2011).

In this paper, we focus on the investigation of a rapid developing "virtual-currency" phenomenon particularly in the SNS websites of mainland of China. We noticed that in recent years there has been a virtual-currency service widely supplied by China's SNS companies and the virtual-currency service is reported to have brought a large amount of profit to the companies (Chew, 2011). Some researchers have already done certain work about the condition of virtual-currency in China: in 2007, Tian first analyzed the payment method of virtual-currency in China's payment environment(Hui, Linyu, & Hong, 2009); Hui's study in 2009 mainly focused on the demand and supply of the virtual-currency(Tian & Zhang, 2007), and Zhen in 2009 gave a definition and catalog of the virtual-currency in China(Zhen & Bin, 2009a); in 2011, Chen analyzed the proprietary rights of virtual-currency in SNS world. However, little work was done on systematical analysis about the circulation mechanism of virtual-currency. Why virtual-currency services in SNS websites are so profitable and how can SNS companies improve their present virtual-currency operation mechanism to get more profit? Concentrating on these two problems, our research tries to find models to systematically analyze the existing virtual-currency mechanism. We use certain economic theory and algorithms to speculate virtual money's influence to actual and virtual world under different virtual-currency models. The final objective of this paper is to propose an improved model for the SNS companies which supply the virtual-currency services, and conduct a survey to evaluate the feasibility of the improved model.

This paper is organized as follows: in the next section, some background knowledge including the definition, the functions, and the risks of virtual-currency will be given. By reviewing the previous works, in section 3, we introduce the ideal model and existing model of virtual-currency. In section 4, we present an improved model and give the comparison analysis among the proposed model and the models in section 3. In section 5 we will collect the result of the survey to analyse the feasibility of the improved model. The last section gives the conclusion and future work.

2. Background knowledge

2.1 The definition of virtual-currency

At present, the definition of virtual-currency (also known as webcoin, electronic money, etc.) has not been determined. In this paper, based on some previous researches(Hui et al., 2009; Zhen & Bin, 2009b), we give our definition of virtual-currency: "virtual-currency is token money used for trading virtual goods within various online communities including social networking websites, virtual worlds and online gaming sites." Generally speaking, virtual-currency in the social network could be categorized into two types.

- Game coin

The first is the well-known game currency. Since the emergence of the Internet as well as the rise of online games, there exists a "financial market" of the game currency, the game currency and game items can be traded between players. There are so many game coin trading platforms, such as IGE.com in the USA, IGXE.com.cn in China, and 8ItemBay.com in Korea.

- Special money for Portal and SNS

The second is a special currency which is issued by the SNS providers particularly in China. The special currency is used for purchasing certain services. The most widely used currency is Q coin of QQ.com, with an exchange ratio 1:1 for RMB. Q coins can be used to buy virtual products such as items to use in games, or accessories for the avatar that they use for instant messaging conversations. But QQ.com only allows one-way flow between Q coin and RMB[†]. Q coin cannot be exchanged into RMB officially. In this paper, our investigation will mainly be concentrated on the condition of this kind of virtual-currency.

Based on the definition of virtual-currency, some unique features of virtual money are shown in Table 1.

However, we like to point out another kind of electronic money, such as wealth in PayPal in USA or wealth in Alipay in China. This electronic money is used for online shopping and not considered as virtual-currency in our definition. Although they might be regarded as virtual-currency by some researchers(Zhen & Bin, 2009b), we consider that this kind of electronic money is only another form of legal tender actually controlled by the banking system. Accordingly, they are excluded from our definition.

Table 1. Features of virtual-currency

Features	Description
On-line payment	All the payments in virtual money should be done online.
Pre-payment	Virtual money should be prepaid.
Commodity	For users, virtual money is a kind of commodity which can be exchanged for other virtual products.
Circulation	Virtual money attends the circulation of virtual products.
Network-	Virtual money depends on the issuer's

[†] 1RMB=0.1575USD

dependent	website and its users. The more its users are, the more valuable virtual money is.
Virtually	Virtual money only exists in the virtual world. In real world, it's a virtual form of real money.
Privacy	The exchange online is not face-to-face, the users can keep their privacy.
Zero-cost	The marginal cost of virtual money is nearly nil (i.e. 0), Like other virtual products, virtual money can be produced unlimitedly
Use-limit	Virtual money can only be used in its own website, and the products and users are both limited.

2.2 Virtual-currency functions of social network sites

Like traditional money possession, virtual-money has several functions as a currency, including three basic functions as a measure of value, a medium of circulation and deposit; as well as two other functions as a medium of payment and world money(Castronova, 2002). But there's something different in SNS. Virtual-currency has three functions as a special currency:

- Measure of value

Virtual money can be used as a measure of other production or services' value. Specifically, virtual-currency in SNS came out in a comparatively mature period, which is used to measure other virtual products' value, in order to provide convenience for the payment.

- Medium of deposit

Virtual money has been considered as a kind of property in online economy, because it can be used to buy a variety of virtual products and services. Therefore, users tend to deposit a certain amount of virtual money, so that they can buy any virtual products or services at any time. In SNS, users won't exchange for virtual coin every time they want to purchase goods. Instead, they usually exchange real money for a certain amount of virtual coins one at a time, and spend them when needed.

- Medium of exchange

Virtual-currency can be used to buy virtual products and services which are provided by the company. But usually in most of the SNS, users are not allowed to sell the virtual products they have bought. Accordingly, it serves as medium of exchange rather than a medium of circulation.

2.3 Complement background: The risks of virtual-currency

In the whole circulation of virtual-currency in real life, its circulation faces some possible risks:

- Legal risk

We must note that we lack reference laws about virtual-currency trade currently. But the online business and private trade of virtual-currency have been increasing rapidly in recent time.

- Devaluation

The virtual-currency is produced by the company, which determines the amount of the currency in circulation. This means that, the virtual money can be produced as much as the company wants while keeping the exchange ratio steady. It may cause the loss of credibility and authority. And the virtual-currency will be subject to devaluation in private trade.

Some experts hold the idea that virtual-currency may make a great impact on actual currency(Xie & Sun, 2011), though they cannot give persuasive facts to support their points. In this paper, we consider that virtual-currency will not generate great impact on actual money only if the company and government can enhance the management of virtual-currency and the legal practice of the business respectively. Hence, we are attempting to illustrate this association and propose an improved model to assess the success of virtual-currency in social networks.

2.4 The currency model and important terms

It is known that, virtual-currency has in possession some functions of our money currency, but it's quite different from legal tender. In this study we take it as near-money to see the difference from legal tender. Figure 1 is the model of legal tender having three mechanisms.

Figure 1. Three mechanisms of currency model

We will establish three virtual-currency models to see their influences to the real world and virtual world. Before the three models are introduced, some important terms must be explained.

- Virtual money supply

Money supply is the amount of a currency in circulation, including both nominal amount users exchanged with real money, and extra money the issuer issued for promotion. Eq. (1) demonstrates the

relationship among the virtual money supply, the real money supply and the extra money supply:

$$\text{Virtual money supply} = \text{Real money supply} + \text{Extra money supply} \quad (1)$$

- Issuer:

In SNS, the issuer of virtual money is not a bank, but the company who provides virtual products and services.

- Issuance mechanism

It's the company that determines the price, quality and circulation of its virtual products and services.

- Circulation mechanism

It's the mechanism showing how users spend their virtual money in exchange.

- Withdrawal mechanism

It's a mechanism showing how the virtual money is withdrawn from circulation and back to actual economy.

Table 2. Notation convention

E	virtual-currency' s nominal exchange ratio to real currency （In the paper, we use RMB as reference currency, and one unit price of virtual money is 1/E RMB）
e	the actual price of virtual money, represented in RMB.(the actual exchange ratio)
P	the nominal price of virtual products or services, represented by virtual coin
p	the actual price of virtual products or services, represented in RMB
M	the nominal virtual money supply, represented by virtual coin
m	the actual money supply, represented in RMB
N	free virtual money issued by the SNS companies for promotion

Table 2. shows the notation convention used for the modeling.

3. Theoretical Development: the ideal model and the actual model

Some previous work has been done to describe the three mechanisms of currency model in detail (Lehdonvirta, 2009; Li, 2007; Tian & Zhang, 2007; Xie & Sun, 2011; Zhang, 2007). In this section, we sum up the result of these previous works and present the ideal model of virtual-currency. Additionally, by taking account the real condition of the SNS companies of China, we also describe the actual model of virtual-currency. Unlike the ideal model, the actual model is derived from the investigation on the real condition in China's main SNS companies such as QQ.com and Renren.com.

Our theory about the issue, circulation and withdrawn mechanisms of virtual-currency in SNS are discussed as follows.

3.1 The ideal model of virtual-currency in previous research

Unlike real money, virtual money requires a new model of issuance, circulation and withdrawal. Figure 2 is the ideal model of virtual-currency in China(Tian & Zhang, 2007).

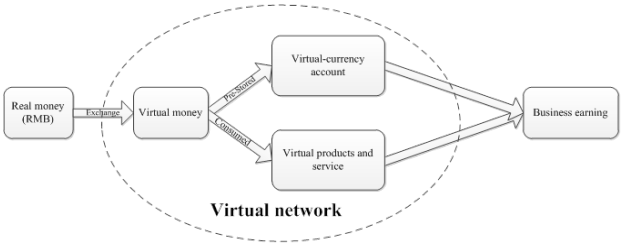

Figure 2. Ideal model of virtual-currency in China

The following assumptions are the fundamental of this ideal model [15].

Assumption 1: actually, the issuance costs are different in different sale channels, so the issuer can only get part of the nominal value of the virtual money. It will be ignored in this study, which means that the issuer will get all of the value of the virtual money, which is RMB per unit. It caused no difference to the result, since the issuer will balance the price of the virtual money in the sale system.

Assumption 2: virtual money is used for purchasing virtual products and services provided by the company, so the company will keep the exchange ratio stable that will win the public trust.

Based on the above two assumptions, we can provide specific illustrations of three mechanisms respectively in the ideal model.

- Issuance

The company issues virtual-currency according to demand. The users can only get the virtual-currency in exchange for actual currency, and the exchange ratio is kept stable.

- Circulation

Virtual-currency can be used in two ways. One is for purchasing virtual products and services; the other is for

depositing into an account. The issuer obtains profit from the business.

- Withdrawal

Virtual-currency cannot be exchanged back for real money, which is a one-way exchange mechanism.

In the ideal model, virtual money, in exchange with real money, entered into the virtual network. The virtual money is stored or consumed for virtual products and services.

In the whole process of the model, nominal exchange ratio E is the same as the actual exchange ratio e, and the prices of both virtual money and virtual products are stable; hence we have the following equations:

$$E = e \tag{2}$$

$$p = P/E \tag{3}$$

$$m = M/E = \frac{\sum_i P_i Q_i}{E} \tag{4}$$

where P_i is the price of the virtual product or service, and Q_i is the quantity of product or service bought with virtual money.

Observations from the above equations show the actual money supply m that makes up all the business earnings of the issuing company, therefore virtual money in this model can be foreseen as a commodity, whereby bringing no influence to the financial real world.

3.2 The actual model of virtual-currency in real condition

After all, the ideal model is far away from the reality. In reality, the situation is more complicated. For example, The Tencent Company which is the service provider of QQ.com and issuer of Q coin, not only allows users to use real money to exchange the virtual money, but also allows users to get some virtual money gratis as promotional activities(Zhuge et al., 2009).

According to the report on the research for Chinese online game players 2010 by CNNIC, QQ.com has ranked No.1 among SNS websites in China in terms of the number of users that occupied 50.4% of user population. In addition, QQ.com has established a circulation system for virtual-currency which is widely used in its user group and brings great benefits to the company. The fact sheet for investors in 2010 showed that the value added service (VAS) of QQ.com paid by virtual-currency called Q coin brought the biggest revenue to Tencent Company[‡].

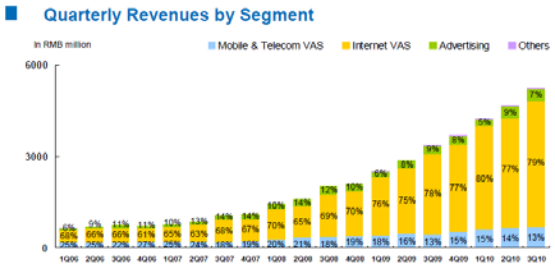

Figure 3. Tencent quarterly revenues by segment

Considering the leadership position of QQ in the SNS services of China(Jiang & Zheng, 2010), the operation model of Tencent Company is very typical in China, and investigating the actual condition of virtual-currency via analysis of Q coin operation mechanism is reasonable.

Accordingly, in the remaining part of this section, we take Q coin as an example to analyse the actual model of virtual-currency in China.

3.2.1 Q coin and its issuance, circulation and withdrawal

As discussed above, Q coin is a very typical virtual-currency issued by QQ.com and allows it to be used for purchasing the virtual products and services (see Table 3)[§] supplied by QQ.com. According to recent released survey result from Alexa research[**], QQ.com has become the largest SNS in China (3rd in the world and 1st in China, much larger than weibo.com which is 34th in the world and 2nd in China). Accordingly, the Q coin is chosen as the example in our study.

Table 3. Application of Q coins

Application	Q coin used
QQ	QQ show, QQ number VIP identity, QQ pet
QQ Zone	Virtual decoration ,VIP identity, QQ house, QQ farm, QQ garden
QQ music	Digital music and video
QQ game	QQ game coin
QQ book	VIP identity

Q coin users can buy almost all the virtual products in QQ.com. However, unlike the ideal model, although Q coin has adopted one way exchange mechanism, some users resell the Q coins to make profits privately. Therefore, the Q coin model is more practical compared with the ideal model. Table 4 shows the structure of Q coin model.

[‡]Source:http://www.mcprc.gov.cn/xxfb/zwxx/whxx/201001/t20100128_76738.html

[§] Source: http://pay.qq.com/paycenter/index.shtml

[**] Source: http://www.alexa.com/topsites/global;0

Table 4. Structure of Q coin model

Issuance	RMB standard
	Extra Q coin
Circulation	Purchase QQ products and services
	Deposit in QQ accounts
Withdrawal	One-way officially
	Private exchange

We give the detailed illustration of the three mechanisms of Q.com in the following:

- Issuance

QQ.com issues Q coins according to the users' demand. The users can exchange one RMB for one Q coin in several ways; including the use of credit card, mobile phone, PayPal and Alipay, Internet bank casher services.

Besides RMB exchange standard, QQ.com issues some extra Q coins for free. For example, the website often gives a certain amount of free Q coins to the users for promotion. In another way, the website gives the users free Q coins as a bonus for clicking upon certain advertisement web pages.

In addition, through vulnerable security relating to online piracy; criminals may be able to decipher a QQ account and obtain the Q coins illegitimately.

- Circulation

QQ, as important as MSN and Facebook nowadays, has possessed a large number of users in China. Not only youths but also adults are using QQ every day. Internet applications such as QQ farm, QQ Zone, QQ music, QQ clothes are quite popular amongst office workers. These brought a huge market for Q coin.

QQ can be used to pay for a small number of bills. And it is very easy and convenient to support bill payments for users with no charges. Users may deposit some Q coins into the same QQ account for common use.

- Withdrawal

QQ.com has adopted a one-way exchange mechanism, which means the users can exchange RMB for Q coins but they cannot exchange Q coins for RMB. It protects RMB from the influences of virtual-currency and exchange risks.

3.2.2 The virtual-currency model in real life

By analyzing the real condition of the Q coin, we can give the real life model of virtual-currency in China. Five assumptions will be given first as fundamental to the real life model:

Assumption 1: different issuance costs through different sale channel will be ignored in this model, which means that the issuer will get all of the value of the virtual money, which is $1/E$ RMB per unit. It gives no difference to the result, since the issuer will balance the price of the virtual money in the sale system. (Same as Assumption 1 in the ideal model)

Assumption 2: virtual money is used to purchase virtual products and services provided by the company, so the company will keep the nominal exchange ratio E stable。

Assumption 3: there is no difference between RMB standard virtual money and the extra money, in other words, when used in purchasing activities in SNS, these two kinds of virtual money can represent the same value.

Assumption 4: we use A to represent a set of goods in a SNS, and nominal prices of the goods are kept stable.

Assumption 5: the issuing company such as QQ.com has enhanced both security and IT management to avoid private business. Hence, the Q coin is not permitted to be transferred between accounts, although it allows third party to help pay the virtual goods for the buyer. It was reported that some hackers invaded the QQ's system and illegally obtained lots of Q coin and then sold the Q coin on to the black market for profit[††].

Based on the above five assumptions, we can construct the actual model of virtual-currency in the real SNS. Figure 4 shows the virtual-currency model in reality(Tian & Zhang, 2007).

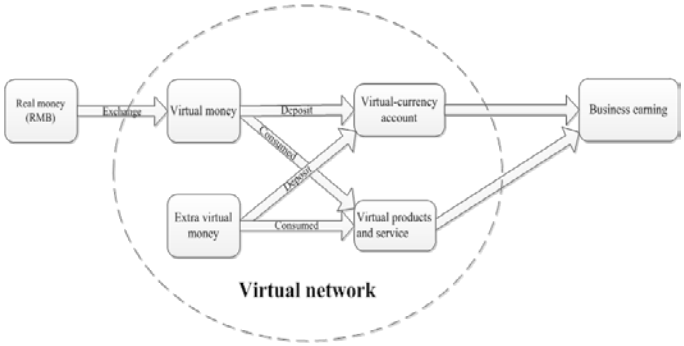

Figure 4. Virtual-currency model in real market

The following give specific features of the actual model in real life.

- Issuance

In real life, the company issues virtual-currency not only according to demand, but also according to other facts. Unlike traditional products, virtual money is similarly like information products that demands enormous cost in the initial R&D processing; but little cost in production, meaning the total cost is large, but most part of the total cost is sunk cost and the marginal cost is almost nil (i.e. 0). Therefore, the company may at

[††] Source: http://it.southcn.com/9/2011-08/22/content_28684473.htm

time offer extra but free virtual money for promotion or advertisement.

- Circulation

Virtual-currency can be utilized in two methods as seen in the ideal model. The first method is to purchase virtual products and services and the second; is to be deposited into an account. The issuer receives business profit from such a circulation mechanism.

- Withdrawal

In real life, the issuer is abided by the one-way exchange mechanism. There is no way for virtual-currency to exchange back to real money.

In this actual model, we use N to denote the extra virtual money and the total amount of nominal money supply M' is:

$$M' = M + N \tag{5}$$

As we discussed above, in the real life, the virtual money is basically for purchasing some information products. The total amount of real money is not affected in this model. So we have:

$$m' = m \tag{6}$$

When the actual exchange ratio e' increases, it implies that one unit RMB can exchange for more virtual money than before.

$$e' = \frac{M+N}{M} \cdot E > E \tag{7}$$

We also have:

$$p' = \frac{p}{e'} = \frac{M}{M+N} p < p \tag{8}$$

When the actual prices of virtual goods p' decrease, it implies that the issuing company has issued extra virtual money for promotion, while the nominal prices of virtual goods should be kept stable. Therefore the nominal prices would fall.

Under the present issuance mechanism, inflation won't happen in SNS, because of the stability of the nominal prices of virtual goods. From Eq. (7), the purchase power of RMB to virtual money is stronger than before. But not every user who exchanged for virtual money could receive free virtual money; thanks to the random promotion.

In the actual model, virtual money cannot be exchanged back to RMB, so the company has to provide enough quantity of virtual goods: $Q' = \frac{M+N}{P'}$, which is more than that in the ideal model. It can hardly cause any effect to the profit, because of the low cost of virtual goods. Virtual products can be easily reproduced limitlessly, so its marginal cost is nearly nil (i.e. zero)(Meng & Wu, 2006). Consequently, the company can keep extending its customer base, and obtain more advertising revenue through issuing extra free virtual money. As a result, the profit of the issuing company will be increased dramatically over the long term.

4 An improved model of virtual-currency

In the last section, we have reviewed some previous researches and sum up the ideal model; what is more, we also have presented the actual model based on the analysis of Q coin operation under present conditions. Observing the two models, we will notice that in both of the two models, the virtual-currency actually plays as medium or token so that users can use real money to buy the virtual products.

In this section, we investigate further for an improved model with certain additional withdrawal mechanism of virtual-currency that can be incorporated in SNS, specifically, in the improved model; we will try to consider the virtual-currency not only as a medium between the real money and the virtual products, but also as a medium between the real money and the real goods. Additionally, we will also consider an option of exchanging virtual money for real money as a complementary of our model.

4.1 Purchase actual goods with virtual money

In both of the ideal model and actual model, virtual money can only be used to buy virtual products and services, or be deposited into an account. We may consider the possibility that using virtual money to purchase actual goods with the precondition that the exchange ratio E of virtual money to RMB is kept stable. Since RMB is legal tender, the seller of actual goods needs to exchange virtual money for RMB. Therefore, the seller and the issuing company have to make an agreement that the seller accepts virtual money as a payment medium; what is more, the issuer will withdraw the virtual money from the seller with a certain price ratio.

In this model as shown in Figure 5, let's denote E_1 as the exchange ratio of RMB to virtual money, E_2 as the exchange ratio when users buy actual goods with virtual money, E_3 as the exchange ratio that issuers withdraw virtual money from the sellers.

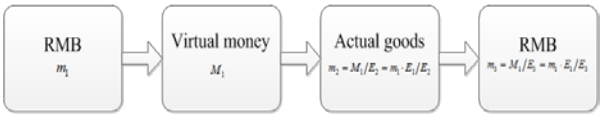

Figure 5. Relation schema of actual goods purchase with virtual money

Let θ percentage of virtual money be used in actual goods exchange, which can be predicted by the statistics

of empirical value, M_1 be the nominal value of virtual money used in actual goods purchase and m_1 be the actual RMB value of M_1. We have:

$$M_1 = (M+N)\cdot\theta \quad (9)$$

$$m_1 = M_1/E_1 = (M+N)\cdot\theta/E_1 \quad (10)$$

Let m_2 be the actual RMB value of the actual goods bought by virtual money. In other words, m_2 is the amount of money earned by the sellers if the goods is sold to the consumer via traditional trading channel (for example, trading in the shop with real money). What is more, as we discussed above, the seller of real goods will accept virtual money as a payment medium and the issuer will withdraw the virtual money from the seller with a certain price ratio, setting the actual RMB value of virtual money in this process as m_3. Here we have to emphasize that unlike virtual products whose marginal cost is nearly nil, the sellers have to at least earn the marginal cost of the real goods to avoid the losses. If we use c to denote the cost of the real goods, the sellers will get profit $\pi_t = m_2 - c, (c>0)$ via traditional trade channel, and we have $m_2 \geq c > 0$ as the condition that the sellers can avoid the losses.

If the prerequisite $m_2 \leq m_3$ is true, we can observe that the actual goods sellers can receive extra profits: since the cost of real goods is c as we discussed above, and the users spend m_3 (the amount of money) to purchase the real goods, obviously, the total profit obtained by the real goods sellers in the improved model is $\pi = m_3 - c$, since $m_2 \leq m_3$, we can easily get that $\pi \leq \pi_t$. Thus, in the improved model, the profit for sellers can be divided into two parts, one is $\pi_t = m_2 - c$, which also can be obtained via traditional trade channel as we discussed above; the other part is the extra profit $\pi_e = m_3 - m_2 \geq 0$, which can only be obtained via the proposed improved model. Accordingly, the sellers can get the total profit $\pi_t + \pi_e = (m_2 - c) + (m_3 - m_2) = m_3 - c = \pi$.

Thus, under the more profitable condition, we have:

$$m_2 = M_1/E_2 = m_1\cdot E_1/E_2 \leq m_3 = M_1/E_3 = m_1\cdot E_1/E_3, \quad (11)$$

From Eq. (11), we can get:

$$E_2 \geq E_3. \quad (12)$$

Similarly, we can get $m_1 \geq m_3$, so that the issuing company can get profits $\pi_i = m_1 - m_3 \geq 0$, and we have:

$$M_1/E_1 \geq M_1/E_3 \quad (13)$$

From Eq. (13), we can get:

$$E_1 \leq E_3 \quad (14)$$

The above equations lead to

$$E_1 \leq E_3 \leq E_2 < e \quad (15)$$

If $E_1 = E_3 = E_2 < e$, users can return their money and the seller can price the actual goods with the nominal price of virtual money. Unfortunately, the issuer will receive a deficit since that there are $N\cdot\theta$ amount of virtual money obtained by users from the issuer's promotion without any payment.

From the Eq.(11), Eq.(13), we can see that only if the prerequisite in Eq.(15) is met, both of the issuers and sellers can get profit. Users bought m_2 value of actual goods with m_1 value of money. For the users, the cost of using virtual money as a payment method is $C = m_1 - m_2 > 0$, and the seller will get an extra profit $\pi_e = m_3 - m_2 \geq 0$. And the issuer will get a profit of $\pi_i = m_1 - m_3 \geq 0$. Then we have:

$$\pi_e + \pi_i = (m_3 - m_2) + (m_1 - m_2) = m_1 - m_2 = C \quad (16)$$

The Eq.(16) reveals that the cost of using virtual-currency as a payment method is finally converted into the profit and shared by the issuers and the sellers. We may also calculate the ratio of the profit obtained by the issuers and the sellers:

$$\pi_i/\pi_e = (m_1 - m_3)/(m_3 - m_2) = (m_1 - m_1\cdot E_1/E_3)/(m_1\cdot E_1/E_3 - m_1\cdot E_1/E_2) = (E_3E_2 - E_2E_1)/(E_2E_1 - E_3E_1) \quad (17)$$

From the Eq.(16) and Eq.(17) we can see that both of the issuers and the sellers can get profit from the users' cost of using virtual-currency as a payment method, and how is the profit sharing depends on how the exchange rates E_1, E_2 and E_3 are set.

Another condition is $m_1 \leq m$, we have:

$$(M+N)\cdot\theta/E_1 \leq M/E_1 \quad (18)$$

$$N \leq M\cdot(1-\theta)/\theta \quad (19)$$

So when the pre-requisites in Eq.(15) and Eq.(20) are met, the actual goods purchase is practicable and profitable for issuers and sellers in the virtual money model. But in the model with this condition, the business earning of issuer will decrease, which is:

$$m - (M+N)\cdot\theta/E_3 = m - m_3. \quad (20)$$

Figure 6 is the purchasing model of actual goods.

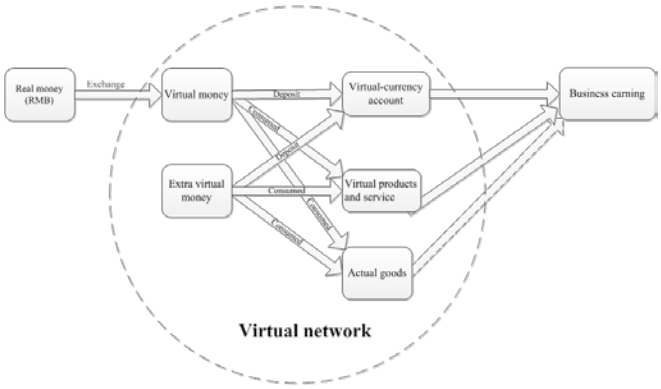

Figure 6. An improved model with actual goods purchasing

4.2 The comparison between the improved model and the actual model of virtual-currency

The following lists the main differences between the actual model and the improved model:

First of all, there are two parts being involved in the activities of the actual model of virtual-currency. The issuer (such as the QQ.com) who is the service supplier of SNS, issues the virtual-currency to users who are in another part of the model. They can use these Q coins for purchasing virtual products in their daily activities of SNS. However, in the improved model, there are three parts including the traditional real goods seller together with the issuer and the users who are engaged in the trading activities. The users may use virtual-currency to buy real goods from sellers, and sellers can exchange the virtual-currency into the real money from the issuers.

Secondly, in the actual model, the profit of the issuers is obtained from selling the virtual products to the users. Since marginal cost of the virtual products is near to nil, the profit obtained by the issuers can be considered as $m-0=m$. In the improved model, from the discussion above in Eq.(16), users need to bear extra cost $C=m_1-m_2>0$, and the issuers can earn profit π_i, what is more, as a new part of the virtual-currency circulation model, the sellers can also get extra profit π_e.

Thirdly, in the actual model, the function of virtual-currency is mainly limited to the trade medium of virtual products, and can be used as a token to measure the value of the virtual products and virtual services. In the improved model, the function of virtual-currency is extended: the virtual money not only plays the role as in the actual model, but also can be used as trade medium of real goods, and can be used as a token to measure the value of the real goods.

Compared with that in the actual model, the three parts involved in the improved model, the issuer, the seller, and the users, all have to face some changes:

- The issuer

The actual model is profitable for the issuer. From the above analysis, we can see that the issuer can get profit π_i. However, issuer needs to deal with more complex conditions than in the actual model. In the actual model, the issuers only need to issue virtual money and trade with the users. But in the improved model, as shown in Eq.(17), issuer needs to negotiate with sellers to set E_2 and E_3 so as to decide how to assign the profits to the sellers.

- Seller

The seller is a new part in the improved model. In the actual model, the seller is absent. However, from the above analysis, we can see that in traditional channels the profit acquired by the seller is π_t, and in the improved model, the sellers can get profit $\pi=\pi_t+\pi_e$. Accordingly, if the improved model can be established successfully, the sellers can obtain higher profit than that in traditional channels which use real money as trade medium.

- Users

From the above analysis, we can see that if the improved model can work well, the users will bear extra cost C (see in Eq.(16)) when using virtual-currency as a payment method. In another words, if the users want to buy real goods with virtual money, actually, they will spend more than that with real money. Thus, the improved model will be not attractive for users unless users' extra cost of paying by virtual-currency can be compensated. Accordingly, issuers and sellers have to supply some added values to the users. Only if the supplied added values can cover the extra cost C, the improved model can be attractive to the users. Some possible methods to supply the added values are discussed in the remaining section.

One of the possible methods to attract users to use virtual-currency is for it to be exchanged with real goods and meeting the extra cost of some "theme product". For example, the real goods can be decorated with the logo of the SNS sites. Some enthusiastic fans of SNS are willing to consider the logos as a kind of high value added services, so that they will like to use virtual money to buy the real goods with these logos and afford the extra cost.

Another reasonable method depends on the reputation of the SNS sites. The seller's goods can be recommended to the users by SNS. Users may believe that the real goods recommended by the SNS web sites with benign reputation may have higher quality, and SNS website may help the sellers to improve the after sales services. For example, customers may make use of SNS to personalize the products or to communicate with the sellers directly.

Also, the SNS websites may supply some virtual products and virtual services as free gifts to users who purchase real goods with virtual money. These free gifts can be seen as a kind of value added services to compensate the extra cost: when users use virtual money to buy or exchange with real goods, they can obtain some virtual products and virtual services as gifts for free. Since the marginal cost of virtual products and virtual services is nil, the issuer can supply unlimited quantity of virtual products and virtual services as free gifts. These free gifts will not generate any new cost. Accordingly, supplying free gifts as value added services will not reduce the profits of the SNS websites. Setting that the value of the free gifts can be measured as m_b in real money, and the extra cost of purchasing real goods with virtual money as C (see in Eq.(16)). If the value of the free gift can cover the extra cost, in other words, $m_b \geq C=m_1-m_2$, it will be attractive for the users to purchase real goods with virtual money.

4.4 A complementary: considering an option of exchanging virtual money for RMB

Another option worth considering is more concerned with the withdrawal of virtual-currency and that is to allow exchanging virtual money back for RMB by the issuer. This is also subject to the reform of monetary policy in the country.

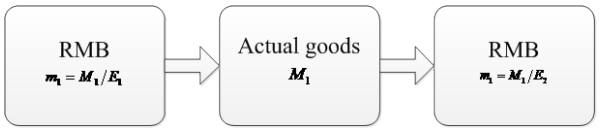

Figure 7. Currency exchange and withdrawal

In this model, as shown in Figure 7, let's say E_1 as the exchange ratio of RMB to virtual money, E_2 as the exchange ratio of virtual money to RMB. We have the following equations:

$$M_1 = (M+N)\cdot\theta \tag{21}$$

where M_1 is the virtual money exchanged back for RMB;

$$m_1 = M_1/E_1 = (M+N)\cdot\theta/E_1 \tag{22}$$

where m_1 is the actual RMB value of M_1.

For issuer, we have:

$$m_1 \geq m_2 \tag{23}$$

$$m_1 \leq m \tag{24}$$

where m_2 is the amount of RMB that users can get.

Accordingly, we can obtain:

$$E_1 \leq E_2 < e \tag{25}$$

$$N \leq M\cdot(1-\theta)/\theta \tag{26}$$

Under the above two conditions, for the issuers, the suggested exchange mechanism is practicable and profitable in the model and it will help control the issuance of extra free virtual money.

5. Survey result and analysis

A survey is designed to evaluate the feasibility of the improved model. It focuses upon the side of consumers. From the survey, we are going to study the demand of the consumers and analyze that if the improved model can meet the expectation of consumers.

5.1 Data collection

We did a survey among users of SNS in mainland of China. The users are mainly from four largest SNS in China: QQ.com, weibo.com, renren.com and kaixin001.com. Finally 859 valid feedbacks were collected during the period between March 18 and May 18 of 2011. There are three parts in the survey consisting of multiple choice questions. It covers:

- General information

Such as gender, age, education and current residence

- Basic questions about virtual-currency

Such as the virtual-currency they usually use, the frequency of usage and their cost on virtual-currency purchase.

- Views on specified virtual-currency

Such as their views on virtual money they usually used (see Figure 8)

1=Strongly Disagree	2 =Disagree	3=Disagree agree	4 =Agree	5 =Strongly agree
It's very convenient to exchange RMB for Q coin.	1	2	3	4	5
It's very convenient to purchase QQ product with Q coin	1	2	3	4	5
The pricing of the QQ products and Q coin are satisfactory.	1	2	3	4	5
It's better to extend the usage of Q coin, such as purchasing real products or other company's products with Q coin.	1	2	3	4	5
It's better if it allows for the exchange from Q coin to RMB.	1	2	3	4	5

Figure 8. Sample survey

5.2 The analysis methodology

In this survey, five hypotheses are proposed to evaluate the feasibility of the improved model. Statistical analysis is applied to the feedback of our survey. We test the hypothesis by using the chi-square goodness-of-fit test method(Groebner, Shannon, Fry, & Smith, 2011).

The Chi-square goodness-of-fit test statistic is:

$$\chi^2 = \sum_{i=1}^{k} \frac{(o_i - e_i)^2}{e_i} \tag{27}$$

where o_i denotes the observed cell frequency for category i, e_i denotes the expected cell frequency for category i, K is the number of categories.

We calculated the observed number of each item by our survey, and then computed the Chi-square goodness-of-fit test at last. The conditions of each hypothesis include:

(i) The number of opinions denoting "blank", "strongly disagree", "disagree", and "neutral" respectively is evenly distributed and occupied 50% of respondents; the number of opinions including "agree" and "strongly agree" respectively is evenly distributed and occupied 50% of respondents.

(ii) The percentage of total users with the opinions denoting blank, strongly disagree, disagree, and neutral is $50\%/4 = 12.5\%$ respectively; and the

percentage of total users with the opinions of agree and strongly agree is $50\%/2 = 25\%$ respectively.

(iii) The hypothesis test was set at the significance level $\alpha = 0.10$.

(iv) The df (degree of freedom) for the chi-square test df = the number of categories $-1 = 5$.

5.3 Hypothesis testing

This section presents the result of our survey. By applying the statistical analysis method, the five hypotheses are tested respectively.

5.3.1 H1: The study on the convenience of the real money / virtual-currency exchange

Null hypothesis H_0: It's very convenient to exchange RMB for virtual-currency.
Alternative hypothesis H_A: The number of responses per each opinion follows some other distribution.

Table 5 shows the statistical result of hypothesis H1.

Table 5. Total users' opinion for hypothesis H1

Total users opinion		
	Observed	Expected
View point	o_i	e_i
Blank	75	107.375
Strongly disagree	46	107.375
Disagree	68	107.375
Neutral	453	107.375
Agree	182	214.75
Strongly agree	35	214.75
Total	859	859

The critical value=9.2363 for an up-tail test with $df = 5$ and $\alpha = 0.10$.Based upon the calculated data from Table 4, we can count $\chi^2 = 1327.25 \geq 9.2362$ in this survey, and the p-value is $7.9752E-285<0.01$. Accordingly, we should reject null hypothesis and the test result is very significant.

As a result, people do not believe it is very convenient to exchange RMB for virtual-currency, so the company of SNS should provide new ideas to solve this problem.

5.3.2 H2: The study on the convenience of using virtual-currency to purchase real goods

Null hypothesis H_0: It's very convenient to purchase virtual product with virtual-currency.
Alternative hypothesis H_A: The number of responses per each opinion follows some other distribution.

Table 6 shows the statistical result of hypothesis H2.

Table 6. Total users' opinion for hypothesis H2

Total users opinion		
	Observed	Expected
View point	o_i	e_i
Blank	76	107.375
Strongly disagree	37	107.375
Disagree	49	107.375
Neutral	422	107.375
Agree	220	214.75
Strongly agree	55	214.75
Total	859	859

We can count $\chi^2 = 1127.89 \geq 9.2362$ in this survey, and the p-value is $1.2184E-241<0.01$. Accordingly, we should reject null hypothesis and the test result is very significant.

As a result, people do not believe it is very convenient to purchase virtual product with virtual-currency, so the SNS should offer some new functions to make it more convenient.

5.3.3 H3: The study on the consumers' attitude to the price of the virtual products

Null hypothesis H_0: The price of virtual products in SNS and virtual-currency are satisfactory.
Alternative hypothesis H_A: The number of responses per each opinion follows some other distribution.

Table 7 shows the statistical result of hypothesis H3.

Table 7. Total users' opinion for hypothesis H3

Total users opinion		
	Observed	Expected
View point	o_i	e_i
Blank	74	107.375
Strongly disagree	90	107.375
Disagree	193	107.375
Neutral	399	107.375
Agree	92	214.75
Strongly agree	11	214.75
Total	859	859

We can count $\chi^2 = 1136.98 \geq 9.2362$ in this survey, and the p-value is $1.3099E-243 < 0.01$. Accordingly, we should reject null hypothesis and the test result is very significant.

As a result, people do not believe the price of virtual products in one SNS website and virtual-currency are satisfactory, so SNS websites should investigate the users and make new price list to attract more people.

5.3.4 H4: The study on the consumers' attitude to extend the usage of virtual-currency

Null hypothesis H_0: It is better to extend the usage of virtual-currency such as purchasing real products or other company products.
Alternative hypothesis H_A: The number of responses per each opinion follows some other distribution.

Table 8 shows the statistical result of hypothesis H4.

Table 8. Total users' opinion for hypothesis H4

Total users opinion		
	Observed	Expected
View point	o_i	e_i
Blank	77	107.375
Strongly disagree	42	107.375
Disagree	94	107.375
Neutral	307	107.375
Agree	282	214.75
Strongly agree	57	214.75
Total	859	859

We can count $\chi^2 = 558.13 \geq 9.2362$ in this survey, and the p -value is $3.42754E-28<0.01$. Accordingly, we should reject null hypothesis and the test result is very significant.

As a result, people do not believe it is better to extend the usage of virtual-currency, such as purchasing real goods, et cetera; so the company should consider whether to extend the usage of virtual-currency.

5.3.5 H5: The study on the consumers' attitude to the SNS allowing for the exchange of virtual-money / RMB

Null hypothesis H_0: It is better if the companies of SNS allows for the exchange from virtual-currency to RMB.
Alternative hypothesis H_A : The number of responses per each opinion follows some other distribution.

Table 9 shows the statistical result of hypothesis H5.

Table 9. Total users' opinion for hypothesis H5

Total users opinion		
	Observed	Expected
View point	o_i	e_i
Blank	73	107.375
Strongly disagree	43	107.375
Disagree	64	107.375
Neutral	177	107.375
Agree	290	214.75
Strongly agree	212	214.75
Total	859	859

We can count $\chi^2 = 138.67 \geq 9.2362$ in this survey, and the p -value is $2.2415E-118<0.01$. Accordingly, we should reject null hypothesis and the test result is very significant.

As a result, people do not think it is better to allow for the exchange from virtual-currency to RMB.

However, the probability of agree and strongly agree is 58.44% which is more than 50%. In the survey of all five hypotheses, the probability of agree and strongly agree is 25.26% (in 5.3.1), 32.01% (in 5.3.2), in 11.99% (in 5.3.3), 39.47% (5.3.4) and 58.44% (in 5.3.5). So the hypothesis H5 in 5.3.5 is the only significance whose probability of agree and strongly agree exceeds 50%. As a result, the hypothesis H5 in 5.3.5 is not fitting the constraints of an evenly distributed subject that is the condition in order to simplify the calculation, so SNS could consider seeking support for allowing the exchange from virtual-currency to RMB.

6. Conclusion and limitations

In this paper, we use the knowledge of monetary economy and E-commerce to investigate how virtual-currency makes profit for SNS and its influence to virtual world and actual world. Three models are given to analyse the mechanism of virtual-currency. In the proposed model, implementing an option for withdrawing virtual money is a good and feasible withdrawal mechanism from both theoretically standpoint and users' view point. Purchasing actual goods will bring extra profit for SNS service suppliers and real goods sellers; however, the customer needs to bear the extra cost of the improved model. Accordingly, if the companies are allowed to have the option open, it must consider how to attract the customers to take part in the improved model. Survey and data collection are used to support the effect of the new model. Moreover, the value of θ can be optimized depending on the market demand on different types of goods and services.

In conclusion, virtual-currency ideally can be converted back to RMB in SNS, and the company should open the option to use virtual-currency to buy real goods only if it is considered from the users' perspective.

However, our research has some limitations. First of all, in the processing of using the statistical method to evaluate the proposed model, the statistical means which called chi-square test is only an approximation for the true distribution for contingency analysis. As a result, the null hypothesis may be rejected because the result must fit all conditions. However, in reality we could accept some conditions which are not to be considered like the numbers could not evenly be distributed. Secondly, as we discussed above, to test the feasibility of the proposed model, our survey mainly focused on the consumers' attitude. Accordingly, there is a lack of consideration on the company's attitude in our survey. Thirdly, based on our proposed model, being able to withdraw virtual money is a good and feasible withdrawal mechanism from both theoretical standpoint and consumer attitude. However, more work needs to be done to investigate that

whether the proposed withdrawal mechanism is implementable and legally feasible. Last but not least, our proposed model is only theoretically feasible. We cannot correctly evaluate the proposed model until some SNS companies practice this model in the real world.

Acknowledgment

The authors acknowledge the partial support of LTG09-12/SS/COMP2 and CRG grants of The Hong Kong Polytechnic University.

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