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USING SIMULATION AND GAMING TO DESIGN A COMMUNITY CURRENCY SYSTEM

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ABSTRACT

We position gaming and simulation as one method for designing a community currency (CC) that matches the local customs and institutions at the introductory stage and discuss the effects of this method by analysing the results of the attempts made so far. In order to learn the CC system and to promote common understanding among different stakeholders, we made The Community Currency Game (CCG). We implemented the gaming to the residents who were planning to introduce a CC into their town. In the gaming, participants' attitudes towards the diversity of money were positively affected and they began to recognize that the social network created by CC is important to the region. We found that through the virtual use of a CC in gaming, it is possible to share knowledge of participants' perception of the CC and their resulting behaviours and utilize this knowledge to discuss a fundamental aspect of the CC and its design. We constructed a computer simulation model based on CCG to identify the factors that promote the circulation of CC. We found that the purchase rates of the area within town increased within three parameters: the premium rate of CC, the proportion of the CC in salaries, and the probability of volunteers with CC. As residents began to offer discounts according to the premium rate of the CC, shop evaluations inside the area increased. Therefore, this policy stimulates the local economy. However, the cost of the CC issue increased owing to the premium. On the other hand, policies in which the resident agents' salaries were paid with CC and volunteers were paid by residents with CC are sustainable. These policies do not directly stimulate purchases inside the town. However, the purchase rate of the area within town gradually increases with the ratio of the CC in salaries. Moreover, the probability of volunteers increases according to habitual use of CC, community-oriented values, and the balance of CC. In this study, we found that simulation is an excellent method of presenting specific scenarios for a CC design based on the discussion in the gaming. Within the cooperative relationship between community residents and researchers, a method utilizing both gaming and simulation can be effective in designing a CC in the introductory stage, which until now, has been carried out on an ad hoc basis.

This paper focuses on the diverse development of modern community currencies (CCs) in Japan and provides a classification of them by type. Modern CCs appeared in the early 1970s and since then various types have circulated globally. With the increase in CC practices, academic research into CCs has emerged as a growing area of interest. However, since CC systems are diverse, it is difficult to obtain a commonly recognized definition of CCs, or criteria for their classification according to their characteristics. Since this problem is shared even by international researchers, it has become an important issue in the field. In this study, we confirm the definition and classification of CCs by surveying previous studies on Japanese CCs. Furthermore, this paper reveals the reality of CC systems that continue to evolve through a process of development and decline, by looking back at their history. In order to explain the evolutionary process, we employ the concept of

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"countermovement," as advocated by economic anthropologist Karl Polanyi. Based on our outcomes, we describe three stages in the evolution of CCs, which are the reciprocal realm, integration between the reciprocal and market realms, and new realms.

KEYWORDS

gaming simulation, multi-agent simulation, institutional design

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1. PROBLEMS IN INTRODUCING COMMUNITY CURRENCIES

Since the 2000s, many types of community currencies (CCs) have been issued and utilized in Japan (Nishibe 2013), some of which have encountered sustainability problems. Yamazaki (2013) reported that about 60% of CCs in Japan were terminated or suspended because of a circulation failure within certain areas. Some articles pointed out that CCs encounter several types of problems. Sakata (2009) mentioned that it is necessary to build a fund and human resources for a CC to support sustainable regional development. However, Nishibe (2006) said that many organizations that issue CCs are dependent on subsidies and volunteer work; therefore, these organizations will not function efficiently if subsidies were cut and the number of volunteers decreases.

However, CCs do not circulate even if the problem of funds and human resources is resolved. Nakazato and Hiramoto (2011) pointed out that CC transactions are conducted as part of an organization's practice. Therefore, the organization's practice decides the manner of CC transactions. Konaka (2005), from a research survey on the EGG—a CC implemented in the Ekimae Ginza Genki Street in Shizuoka Prefecture—explained the negative perception of this CC, and consequently, the use of EGG did not spread. Therefore, when introducing a CC, it is necessary to consider not only issues of funding and human resources of the organization that will manage the CC and its circulation, but also consider the social and cultural background of the target area. However, in many areas of CC introduction, it was difficult to design a circulation scheme that considered social and economic systems, including the customs and institutions, in the introduction stage. However, it is also fact that researchers and practitioners are yet to devise methods to design such a circulation scheme for CCs. We position gaming and simulation as a method of designing a CC that matches the local customs and institutions in the introduction stage and discuss the effects of this method through an analysis of the results of attempts made so far.

2. PREVIOUS STUDIES IN CC DESIGN

To resolve these problems, it is necessary to establish a platform on which different types of individuals can use CCs that reflect their trading situations. Lietaer and Hallsmith (2006) focus on the purposes of introducing CCs. They define CCs as allowing "localities and regions to create real wealth in their local economy by matching the unmet needs with the underutilized resources" (Lieter and Hallsmith 2006, 2). They state the following steps in establishing a CC: 1) set currency objectives, 2) choose the appropriate currency, 3) recruit the leadership team, 4) choose the right mechanisms, and 5) establish a circulation system. Using a worksheet, an organization considering a CC can satisfy these points and design a CC system. However, sharing the experience of using a CC with various types of stakeholders is difficult and it is necessary to provide such sharing opportunities.

Powell and Salverda (1999) created the Community Currency Role Play to share the experience of using a CC with participants. They define the objectives of the game as follows: 1) create awareness of how resources (especially money) flow out of a community, 2) show how CCS (community currency system) helps plug some of those leaks, 3) show how purchasing power increases through the use of CCS, 4) demonstrate the power of CCS to create interest-free credit, 5) explain the operation of a basic CCS, 6) create awareness of how a community can re-assess value (prices) within the community, and 7) a starting point for discussions on whether a CCS would be feasible/desirable under local circumstances (Powell and Salverda 1999, 3). This method provides an opportunity of using a CC and sharing this experience with participants through discussions. It is necessary to establish the CC system in advance; however, several types of participants in the game make it difficult to set purposes for introducing a CCS. Examining these methods, we find that one focuses on setting purposes for introducing CCs and the other on understanding the mechanism of a CC. The problem seems to be that these methods lack a process to systematically incorporate both purpose setting and the learning process and feedback on each other's achievements. Furthermore, it is necessary to include not only leaders but also various stakeholders involved in the CC system. We consider the gaming simulation suitable for learning how to use a CC[1]. Gaming simulation is "a hybrid form, involving the performance of game activities in simulated contexts" (Greenblat 1988, 15). Gaming simulation enables "an operating model of central features of elements of a real or proposed system, process, or environment" (ibid, 14). Furthermore, gaming

[1] See Yoshida (2012)

simulation is suitable for designing CCs and introducing them into communities[2]. Participants can discuss conditions to examine for a CC to circulate based on the results of the game[3]. However, as the rules of CCs and transactions are determined for gaming, it is difficult to transform them into reference materials when setting the detailed parameters for CC design, which must be set in advance. It is also difficult to discuss and investigate the sustainability of CC circulation from gaming with a limited number of transactions.

Therefore, to solve these gaming problems, we use computer simulations to present possible scenarios of CC circulation and investigate specific CC designs. Methods for analyzing and evaluating multiple assumed measures through computer simulation have previously been used in the field of social simulation. Deguchi (2013) stated that simulations are the most effective method of investigating the influence of parameters and the evaluations of various options. In addition, Terano (2013) discussed simulations as a method to demonstrate the initial and boundary conditions necessary for the analysis and design of social systems. In this study, we consider the effectiveness of simulation and gaming as tools for a common understanding of the goals of a CC system and explore possible scenarios that might result from the introduction of CCs.

3. GAMING SIMULATION TO FORM COMMON RECOGNITION

3.1 The Community Currency Game (CCG)

The Community Currency Game (CCG) is a multi-player, face-to-face, analog game.[4] The purpose of the game is to learn the CC system (how to use a CC?) and promote common understanding among different stakeholders (what is the goal of introducing a CC?).

The main rules of the game are as follows[5]:

- Determine five to eight types of residents in a town (businessperson, student, etc.); each participant is assigned one of these roles and has trading record sheets (see Figure 1).
- The participants throw a dice to determine their trade in goods and services. When participants buy goods and services, they must choose a shop within or outside the town. The price of goods and services inside the town is higher than that outside.
- Participants face some problems (snow removal, etc.), which are determined by the dice. Other participants can volunteer to help. If they perform volunteer service, their income from outside the town reduces ten percent on their next turn, as the cost of volunteer work. In these situations, they must choose to pursue either self-interest or public interest.
- The game consists of two phases. The first phase consists of two turns and participants trade only with legal tender (yen) in this phase. The second phase consists of three turns, in which they trade with legal tender and CC. In this phase, participants must decide the proportion of CC used to pay the selling price of traded goods. Further, participants must decide whether to receive CC for volunteer services rendered.
- We explain to the participants that this town has two big problems: the decline of the local economy,

[2] See Yoshida (2013), Yoshida and Kobayashi (2014a), (2014b), (2015).

[3] Some researchers have used gaming simulation to investigate the conditions for the circulation of CCs (Hayashi and Yosano 2008). These studies noted that the economic divide within a community affects the circulation of a CC. However, as CC issuers cannot operate this condition, it is difficult to apply these studies in designing a CC system. We develop a gaming simulation to search for the operable conditions that affect the circulation of a CC.

[4] This game is inspired by Powell and Salverda (1999) with a substantial change.

[5] For details, see Kobayashi, et al. (2013), Yoshida and Kobayashi (2014a).

and decrease in mutual aid in the community. We make participants think for solutions to these problems. As per the game setting, the more the participants use a CC, the easier it becomes to resolve these problems.

trading record:before introducing a CC					
( )turn					
employee					
	dice(1)	item/sales outlet			volunteer
purchase	1	Home electrical appliances outside the town	Delicatessen supermarket/outside the town	Private teacher student	
	2	Bicycle outside the town	Pancake restaurant/outside the town	Vegetable supermarket/outside the town	
	3	Clothes general store/outside the town	Stay Japanese-style inn	Curry restaurant	Taking pets for a walk student
	4	Delicatessen supermarket/outside the town	Hot spring Japanese-style inn	Chinaware pottery/outside the town	Harvest experience farmer
	5	Spice outside the town	Rice supermarket/outside the town	Delicatessen supermarket/outside the town	Learnig how to cook a curry restaurant
	6	Clothes general store/outside the town	Daily goods general store	China dish pottery	Babysitter student
sale					
item			amount		
full-time job(10000 yen)					
volunteer					
menu			amount		
house cleaning					

income from outside the town	dice(2)	income	amout of volunteering in previous turn	balance
	1,2	0 yen		
	3,4	6000 yen	Did you get a volunteer in previous turn?	
	5,6	12000 yen	Yes No	yen

trading record:after introducing a CC					
( )turn					
emploee					
	dice(1)	item/sales outlet			volunteer
purchase	1	Home electrical appliances outside the town	Delicatessen supermarket/outside the town	Private teacher student	
	2	Bicycle outside the town	Pancake restaurant/outside the town	Vegetable supermarket/outside the town	
	3	Clothes general store/outside the town	Stay Japanese-style inn	Curry restaurant	Taking pets for a walk student
	4	Delicatessen supermarket/outside the town	Hot spring Japanese-style inn	Chinaware pottery/outside the town	Regional vitalization
	5	Spice outside the town	Rice supermarket/outside the town	Delicatessen supermarket/outside the town	Learnig how to cook a curry restaurant
	6	Clothes general store/outside the town	Daily goods general store	China dish pottery	Regional vitalization
sale					
item		CC receipt rule			amount
full-time job	10000 yen=( ) yen+( )S				
volunteer					
menu		CC receipt rule			amount
house cleaning		0S 500S 1000S			
regional vitalization		0S 500S 1000S			

income from outside the town	dice(2)	income	amout of volunteering in previous turn	balance
	1,2	0円		
	3,4	6000円	Did you get a volunteer in previous turn?	
	5,6	12000円	Yes No	yen

Figure 1 Trading record sheets: employee




Figure 2 Situations in the Community Currency Game

3.2 Research method

We apply the gaming to the residents of three towns in Japan: Iide, Tsubata, and Nomi. We choose them because a CC is planned for these towns in the future. Iide is a town in the mountainous Yamagata Prefecture. There are plans to introduce a CC to promote voluntary work in agriculture. Tsubata is a small town in the Ishikawa Prefecture. The introduction of a CC is planned there to promote volunteer work and revitalize the local economy. Nomi is a town in the Ishikawa Prefecture and there are plans to introduce a CC to promote voluntary work in communities. We conducted the gaming on December 4, 2013 in Iide, on January 25, 2014 in Tsubata, and on February 13, 2015 in Nomi. In Iide, 12 people participated; 16 in Tsubata, and 13 in Nomi.

We studied two types of changes in the game. First, we studied the changes in behavior of participants using the CC. In particular, we focused on changes in purchasing and volunteering when the CC was introduced. These changes helped us examine whether participants can learn using a CC. Second, we studied changes in their understanding of and attitude to a CC due to their experience with the game. We gathered survey data on attitude toward money and community-oriented values through pre- and post-game questionnaires and analyzed the responses. We focused particularly on the participants' cognitive social capital and their attitude toward money (Kobayashi et al. 2013).

We had two types of debriefings in this game. The first was conducted after the gaming and its goal was for participants to share their experiences in the game. Each role announced their final balance of legal tender and CC. Then, the participants discussed their experiences in the game and their understanding of a CC. The second type of debriefing was conducted after analyzing the trade history and pre- and post- questionnaire. In this debriefing, we fed back these results to the participants. After sharing their behavior in the game, the participants discussed a suitable CC scheme and its introduction in their town or community. The goal of the second type of debriefing is share the visions of introducing CCs into towns or communities with several types of stakeholders.

3.3 Design of the workshop using the gaming results

The trade history of the gaming noted that: 1) the proportion of items bought inside the town increased after CC introduction (Figure 3); and 2) the rate of volunteering increased after CC introduction (Figure 4).[6] From the pre- and post-game questionnaires, 3) participants' attitudes towards the diversity of money were positively affected; and 4) participants begin to recognize the meaning of a CC network (Table 1).[7]

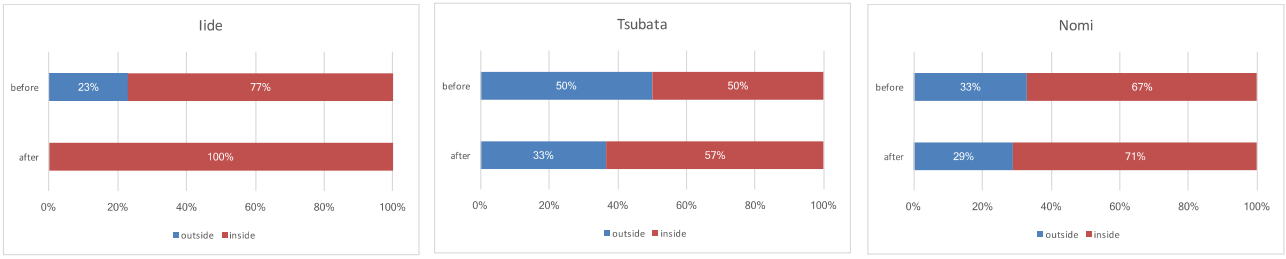

Figure 3 Proportion of buying items inside vs. outside the town

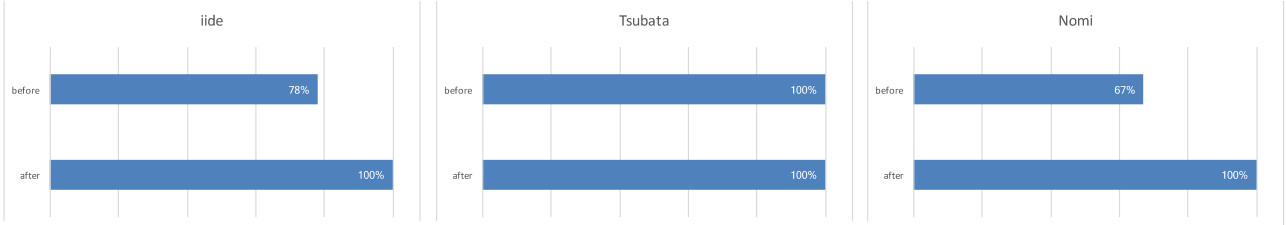

Figure 4 Volunteering rates

6 For details, see Yoshida and Kobayashi (2014a), (2014b).

7 For details, see Kobayashi et. al. (2013).

Table 1 Changes in consciousness through the CCG

Iide (n=11)	Before-experiment Mean	After-experiment Mean	Deviation	*p*- value
Do you think it is good that money can be created or issued freely by people?	2.73	3.18	0.45	
Do you think it is good that money can be issued or created not only by the central bank or commercial banks, but also by people or communities?	2.90	3.50	0.60	$p < .05$
Do you think it is good that money can be something that mutually connects people?	3.60	3.90	0.30	$p < .1$

Tsubata (n=15)	Before-experiment Mean	After-experiment Mean	Deviation	*p*- value
Do you think it is good that money can be issued or created not only by the central bank or commercial banks, but also by the government?	2.67	3.67	1.00	
Do you think it is good for money to be single?	3.40	2.93	▲ 0.47	
Do you think it is good that we can choose favorite ones out of different moneys?	2.73	3.40	0.67	$p < .05$
Do you think it is good that money can be something that mutually connects people?	3.07	3.70	0.63	

Nomi (n=13)	Before-experiment Mean	After-experiment Mean	Deviation	*p*- value
Do you think it is good that money can be issued or created not only by the central bank or commercial banks, but also by the government?	3.75	3.92	0.17	
Do you think it is good for money to be single?	2.42	2.50	0.08	
Do you think it is good that we can choose favorite ones out of different moneys?	3.67	4.00	0.33	$p < .05$
Do you think it is good that money can be something that mutually connects people?	3.83	4.08	0.25	

5: Strongly affirmative, 4: Weakly affirmative, 3: Neutral, 2: Weakly negative, 1: Strongly negative

These results suggest that the gaming does not only teach participants to use a CC but also changes their views on money and community.[8] In debriefing, participants can create a common understanding among many different stakeholders with these results.

From these results, we understand that although within the virtual-space of gaming, there changes to behavior and consciousness occur that to a certain extent reflect customs in reality. Gaming gives the participants the experience of using a CC by presenting the results of the questionnaire and macro data, such as their transaction histories. The

8 In fact, we found a positive feedback relationship between using a CC by volunteering and community-oriented values. See Section 4.

circulation volumes of the legal currency and the CC are always established for a debriefing to enable each participant to reflect on why these outcomes occurred. This makes it possible to not only deepen the participants' understanding of the CC, but also for them to discuss CC design assuming a more realistic image of the local community.

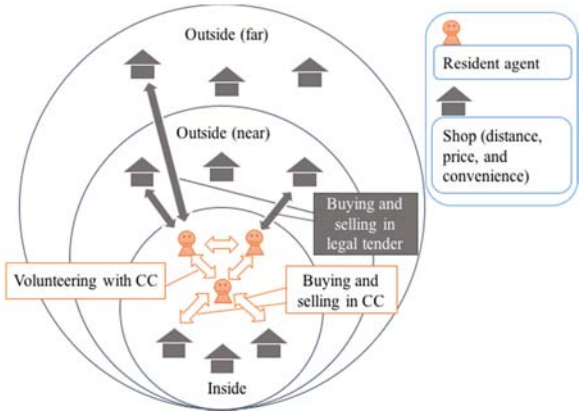

Figure 5 Area Model

We conducted workshops in a number of locations to design a CC using gaming. For example, in Tsubata,[9] various types of stakeholders involved in the introduction of the CC (including researchers and members of the town hall, chamber of commerce and industry, and the social welfare council) participated, and while referring to the game as a whole and the results of the questionnaire, they discussed the effect of CC introduction and what was necessary to circulate it.

The participants expressed positive opinions on the CC, "using a CC allows us to become more aware of the community," and that "members of the community can interact with each other. It develops compassion. It leads to employment." However, they also expressed some negative opinions, such as "I do not think that tender currency will be converted into a CC and used for purchases in the community until a fee is collected" and "I feel that it is good that the community will be revitalized by the CC, but I also feel that its usability is made worse by the restrictions and rules." The discussion after the game confirmed that the CC is to be positioned as a method to rebuild the local community network of mutual help, cooperation, and aid by using the familiar shopping stamps, and that it will be important to collaborate with third parties such as the chamber of commerce and industry, town hall, and the social welfare council to construct the circulation system. Through the virtual use of a CC in gaming, it was possible to share knowledge on how we, and others around us, perceive CCs and our resulting behaviors, and discuss a fundamental aspect of the CC: how to design it.

However, the same results might not appear for all communities in the real world. The number of transactions in the game was finite and the parameters were set assuming that the CC will circulate to a certain extent. Therefore, it is necessary to discuss and investigate the sustainability of the CC's circulation after comparing the game situation to the actual situation in the community.

4. Computer simulation for setting the CC scheme

4.1 The computer simulation model

We constructed a computer simulation model based on CCG to identify the factors that promote the circulation of CC (Kobayashi et al. 2012). In this model, each resident agent in the town probabilistically selects a purchasing shop from three areas: inside the town, outside the town (near), and outside the town (far) (see Figure 5). Their selections are according to the following five factors (probabilities): habitual use of CC, habitual use of legal tender, community-oriented value, evaluation of shops, and the balance of CC. The probabilities of these factors for each agent can change depending on the agent's purchasing behavior.

Each shop has three elements: distance, price, and convenience. In this model, we set these elements as follows:

9 We are investigating the use of shopping stamps issued by the chamber of commerce and industry available as rewards for volunteers. The background to this investigation are the town problems , such as the decline of its commercial district and increase in the number of elderly who require shopping assistance. The idea of turning the shopping stamps into a CC was put forward as a solution to these problems.

- Distance: inside < outside (near) < outside (far)
- Price: inside = outside (near) = outside (far)
- Convenience: inside > outside (near) = outside (far)

Under simulation conditions, we controlled three parameters: premium rate of the CC, proportion of the CC in salaries, and the propriety of volunteers with CC. We observed a change in the purchase rate of the area within town. First, we focused on the premium rate of the CC because a high premium rate tends to increase the velocity of CC circulation and enhance economic revitalization. Second, we focused on the proportion of the CC. The proportion of the CC paid as salaries may control stagnation of CC in shops and promote its use. Finally, we focused on the propriety of volunteers with CC because Kichiji and Nishibe (2012) indicated that CC connects people in a distribution network and not only by the commercial use. We analyzed the promotion of CC circulation with the computer simulation model in Nagaoka.

4.2 Causal loop of the increase in purchase rate

In the simulation, the purchase rate of the area within town increased with the three parameters: premium rate of CC, proportion of the CC in salaries, and the probability of volunteers with CC. However, the mechanism for increasing the purchase rate of the area within town is different (see Figure 6).

The purchase rate of the area within town increases with the premium rate. In this case, shop evaluations inside the area increased, as they offer discounts according to the premium rate of the CC. If the resident agent purchases inside the town, the evaluation of shops within town increase. Therefore, this policy stimulates the local economy. However, the cost of CC issue increased due to the premium. Therefore, this policy is not sustainable.

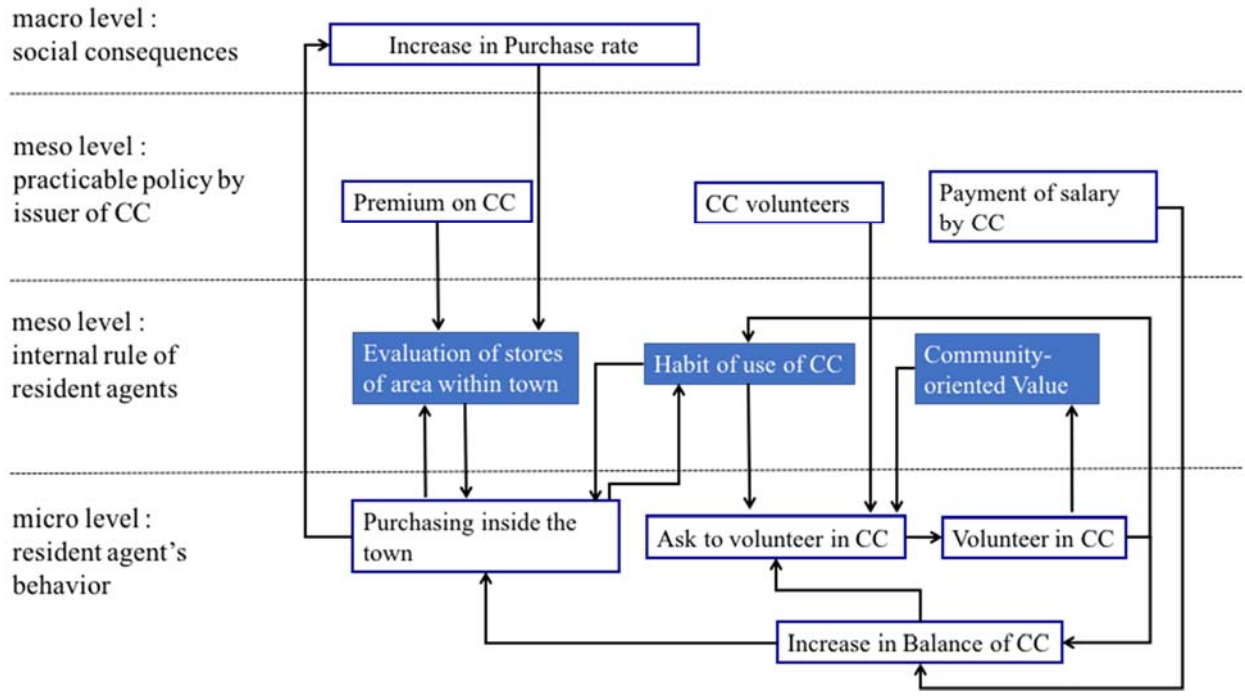

Figure 6 Causal loop of the increase in purchase rate

On the other hand, policies in which the resident agents' salaries were paid with CC and residents paid volunteers with CC are sustainable. However, these policies do not directly stimulate purchases inside the town. The purchase rate of the area within town gradually increases with the ratio of the CC in salaries. Paying salaries with CC increases the balance of CC and shops within town are more likely to be chosen. In addition, the probability of habitual use of CC also increases. Moreover, when residents pay volunteers with the CC, the purchase rate of goods in the area within town increases compared to not paying volunteers with the CC. The choice probability according to the community-oriented value also increases, as the community-oriented values of resident agents develop by providing volunteers. Moreover, as some individuals receive CC through volunteer work, the balance of CC also increases. Consequently, the resident agents have more opportunities to choose shops within town. Furthermore, the probability of volunteers increases according to habitual use of CC, community-oriented values, and the balance of CC.

Therefore, computer simulations have an advantage in that they make it possible to investigate how resident agent's internal rules will affect the circulation of the CC through the long-term transactions conducted in this currency, and how the internal rules will themselves change. However, while it is possible for researchers to evaluate assumed scenarios using computer simulations, the interpretation of the simulation results by the CC management body, which formulates and implements policies, and by the local residents, will be limited due to difficulties in understanding the model itself. In addition, it is necessary to conduct sufficient analysis and implementation to construct a model that includes the gaming results. Thus, it is possible that designing the CC will require substantial time and money.

We consider that game design and implementation should promote an understanding of the model itself. Goto et al. (2014) developed and confirmed the effectiveness of a gaming system to enable the subjects to understand the validity of the simulation model and its results. The simulation model that we implement follows one part of the structure of a CC game; however, by having commonality to the simulation and gaming structure, it may be possible to redesign not only the macro part of the simulation results, but also the part linking the macro to the micro so that it can be inferred by the participants. Constructing a model (Hishiyama, 2014) that follows a multi-agent gaming framework that can instantaneously simulate the changes to the consciousness and behaviors of local residents from the gaming results, it is possible to shift from gaming to simulation and accelerate the analysis.

5. Simulation and gaming as a tool for introducing CC

At the CC introduction stage, the experience of local stakeholders as participants in gaming can be used to not only obtain findings on CC mechanism, but also—by comparing the circulation conditions in the game with those in the community—to facilitate a discussion on matters that are necessary to design the CC. In addition, the interaction between the participants in the game increases the possibilities of obtaining game results that reflect the customs and institutions of the participants' communities. Researchers who conduct gaming observe and analyze participants' behavior histories and changes in consciousness as quantitative data and present this data to the participants, which might enable stakeholders to learn about CC designs that reflect the social and cultural background of their community.

Simulation is an excellent method of presenting specific scenarios for CC design based on discussion in the gaming. In addition, utilizing the participants' behavior histories and changes in consciousness as data to construct an agent model in the simulation contributes to increasing the validity of the simulation itself. Moreover, apart from simulation modeling, they can be used to design the structure of the CC game using simulation. We have already used the simulation to adjust the balance of the CC game. By using the simulation to adjust the game parameters (price, income, etc.) in advance, it becomes possible to create a game that reflects the circulation and the income structure in the participants' actual community. This not only gives the participants a feeling of reality through the game, but can also make the gaming results more closely resemble the actual situation of CC introduction. This method can be used to not only bring the game closer to the community situation, but also to create awareness among participants.

As shown in the discussion, within the cooperative relationship between community residents and researchers, a method utilizing both gaming and simulation can be effective in designing a CC in the introduction stage, which up until now has been carried out on an ad-hoc basis.

However, there are a number of issues with this method. First is the issue of validating the results of the gaming and simulation. Particularly in gaming, the results will differ depending on the characteristics of the participants and their facilitation. It is necessary to deal carefully with the interactions created by gaming, which have a high degree of freedom, and the scenarios created by the simulation results. One method to address this issue is to conduct a debriefing emphasizing the various interactions that occurred in the gaming process, rather than on the gaming results, and then validate the scenario by dropping the scenario obtained from the simulation even further into the gaming, and having the local residents play again. The robustness of the scenarios can be improved by conducting a double check through the simulation and gaming.

Second is the issue of whether a cooperative system between the local residents and the researchers on the method of management, that is, the integration of the gaming and simulation, can be built. When gaming and simulation are used to design a CC, it is vital to have a cooperation system in place between the researchers who initiate them and the body that is managing the CC. However, when introducing the CC there is not only the issue of the scheme in terms of the circulation pathways in the gaming and simulation, but in many cases there are various other issues relating to the people involved. It will be necessary to sufficiently investigate how and to what extent researchers are to be involved in building this cooperation system.

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