

# The reliability of the New Economic Platform: “Mobile Value Exchange Alliance Network”

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## Abstract

In 2004, a handset called the "Osaifu-Keitai" ("Wallet Mobile") equipped with a noncontact IC chip was released by NTT DOCOMO, and new environment for electronic value exchange that assumed the mobile phone network as its platform was launched. Now, many application services (e.g. electronic money via "Edy" and train tickets via "Suica") are offered on this platform. In addition, these e-value "Mobile values" can be circulated between companies on web services according to various alliances.

This paper shows the exchange alliance network for mobile values and elucidates on this social phenomenon using social network analysis for this exchange alliance network. We propose this approach from the viewpoint that using an evaluation model for reliability in the whole system is necessary for the healthy development of the network.

**Key words:** Osaifu-Keitai, Mobile value, Social network analysis, Exchange partnership networks.

## 1. Introduction

In Japan, platform environments in which electronic value circulates via cellular phones equipped with noncontact IC chips are widely and commonly used.

However this is not to say that this platform environment was realised in a single step. The fundamental business scheme and technical packaging know-how currently employed was shaped in "Super Cash" demonstration experiments (phase 1: 1999 - 2000, phase 2: 2000 - 2001) implemented by NTT and NTT Communications in collaboration with 24 major banks. Electronic money, which can be used in the shopping districts of central Tokyo and Shinjuku and in shopping malls on the Internet, is an avant-garde arrangement whereby funds can be withdrawn from a bank account onto a bank-issued IC card by means of a computer the individual has connected to the Internet. This arrangement is used by around 100,000 people.

Meanwhile, Sony developed the noncontact IC chip technology "FeliCa", which was introduced in earnest in 1997 in transportation ticket systems organised by several businesses in Hong Kong. In domestic Japan also, the largest railroad company East Japan Railway adopted this in their transportation ticket systems in 2001. Next in 2004, NTT DOCOMO mounted this noncontact IC chip on a cellular phone and the electronic value distribution platform of today was formed. Other cellular phone business entities such as KDDI also introduced this platform in the autumn of 2005. Currently, the services and mobile telephone devices that utilise noncontact IC chips mounted in cellular phones are commonly called "Osaifu-Keitais"<sup>1</sup> across the industry. NTT DOCOMO has announced that cellular telephone contracts with Osaifu-Keitai support number 34,800,000 at the end of May 2009 and the number of stores accepting their usage has exceeded 900,000. In addition Mobile Society Research Institute of NTT DOCOMO estimates that the number of active users is approximately 10,200,000 people (February 2010 investigation).

Participation from companies in various industries concerning application services has resulted in its growth to a widely and commonly used social infrastructure. The electric money of "Edy" and "WAON" etc., which can be used very similarly to cash and the

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<sup>1</sup> The name "Osaifu-Keitai" is a registered trademark of NTT Docomo, however the trademark is licensed to other corporations.

corporate points such as “Bic Points” and “C-mode” etc. conferred as a bonus for shopping activities can put electronic value into the Osaifu-Keitai and be carried on one person. The large-scale corporate point services not handled by Osaifu-Keitais are the mileage systems of airline companies such as “JAL” and “ANA” and the points issued on the Internet shopping mall “Rakuten”.

There are many cases where by these electronic moneys and corporate points can be exchanged for the electronic value of other service systems through value exchange partnerships between fellow service providers. In addition corporate entities such as “G Plan” and “PeX” exist on the Internet whereby general consumers can exchange corporate points they have accumulated for other electronic monies or corporate points. Current as of January 2010, 164 categories exist for services registered on the website “Poitan”, which provides information regarding these value exchanges.

Previously this area was discussed in the framework of electronic money as electronic money and corporate points as corporate points. However, Yuhashi gave attention to the social phenomena of this value exchange and proposed to capture the present conditions in the general concept of “mobile value”, which has the principal characteristics of (1) economic value circulating whilst its very properties change through the value exchange partnerships being utilized, and (2) the principal intermediary for the electronic value consumed in actual life having migrated to the cellular phone (Yuhashi, 2008, 2009). The sense of the issues in this paper is simply to perform an evaluation of this social phenomenon as a social system perceived in a whole system that uses the concept of mobile value. Hereafter, we will focus on exchange partnerships for mobile value points and give quantitative considerations, including analysis, from the perspective of social network theory.

## **2. Review of Prior Research**

### **2. 1. Case Study**

As the distribution platform for electronic value is the social infrastructure, it can be considered that the network effect functions strongly in its diffusion process. Shapiro et al. explain that value is determined according to degree of diffusion for a social infrastructural commodity or service and indicate that it is important for businesses to create a switching cost for the case consumers transfer to the commodity or service of another corporation, or to design a business strategy with a consciousness of expanding profit due to a large number of users (Shapiro et al., 1998). Research regarding the network effect and switching costs for telecommunications services has been conducted. From amongst those relating to cell phones, Nakamura has estimated that a switching cost of approximately 90,000 yen exists in the selection of a cell phone company (Nakamura, 2008). Also, Yasuda et al. showed that the network effect (positive feedback) is gaining strength through its diffusion process in the example of “Edy” and “Suica” mobile value (Yasuda et al., 2008).

However, cases introduced simply by example are numerous for the social phenomena of mobile value. The reason for this is in the business scheme symbolised by the existence of FeliCa Networks<sup>2</sup>, which is responsible for authentication functions in the distribution platform for this electronic value. FeliCa Networks is a corporation was financed by the cell phone Corporation NTT DOCOMO and was formed from the business department dealing with FeliCa operations that span off from Sony, the manufacturer that produces the noncontact IC chip “FeliCa” mounted in cellular phones in 2004. In 2004, the East Japan Railway, which possesses “Suica”, the mobile value with the most users, increased its capital<sup>3</sup>. The cross-industry scheme by which production manufacturers,

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<sup>2</sup>In addition to conducting authentication at the time of utilization of mobile value services a platform administration business, FeliCa Networks conducts technical licensing business for electronics related to the noncontact IC chip “FeliCa” (cellular phones, IC cards, devices on the reader side etc.)

<sup>3</sup>Capital ratio: Sony: approx. 57%, NTT Docomo approx. 38%, East Japan Railway: approx. 5% (Current as of April 2010).

telecommunications carriers, and application service providers invest in the business responsible for the nucleus of this platform is certainly a business model example of vertical integration.

Whitehead et al. introduce the NTT DOCOMO/Sony business tie-up as an example of the potentiality of mobile value application services to expand through the combination of an electronic wallet and a cell phone (Whitehead et al., 2008). However, as the distribution platform for electronic value was developed on the premise of the relatively secure Japanese society, Whitehead mentions the importance of evaluating the latent possibility for crime in advance with regards to the introduction of similar services in Europe<sup>4</sup>. Concerning the problem of security, Lehdonvirta et al. also indicate that a balance between usability and strength of security is important when using for small sum payments whilst adopting the example of the NTT DOCOMO Osaifu-Keitai (Lehdonvirta et al., 2009). These claims suggest that rather than simply being a technical problem, realistic security measures should be devised with consideration to the social environment of introduction and the convenience of users.

Also whilst adopting the example of the NTT DOCOMO Osaifu-Keitai, Ondrus et al. note that the Near Field Communication (NFC) technology contained in the noncontact IC chip "FeliCa" is promising as the platform for electronic payment. However, they mention the necessity for public transportation and retail agencies to be responsible for a reasonable portion of the cost in joining the business scheme, as issues remain in the expense of outfitting as a social infrastructure.

Outside of Japan, Hong et al. take-up the case of Korea, whereby business services exist for cellular phones in which a noncontact IC chip is mounted. they go on to expound on the business development background in which cellular phone corporations are focusing their attention on mobile commerce as a new source of income, and explain that the provision of mobile value services could become a business opportunity for cellular phone corporations and cooperating businesses of other industries in both Japan and Korea alike<sup>5</sup> (Hong et al., 2009). In this manner much research exists hypothesising the case the business model for the mobile value services implemented in Japan and Korea is introduced to other countries, and arranging the causes of success and points of concern.

## 2. 2. Advanced Analysis

More in-depth and advanced research exists in Japan. Following the announcement by the Bank of Japan in 2006 that the quantity of coins in circulation had moved into decline for the first time since 1971, Kitamura et al. empirically verified the impact electronic money was having on the quantity of money in circulation (Kitamura et al., 2009). Also, Watanabe et al. performed a factor analysis concerning consumer sentiment with regards to electronic money utilising a noncontact IC card and clarified three latent primary factors necessary for diffusion (transportation facilities convenience, insecurity and usage locations) (Watanabe, 2009).

In addition, Yasuoka arranges the present condition of electronic money and corporate points and makes the claim that the development of mobile value services hereafter should be quickened by regulatory policy prioritising economic stimulation (Yasuoka, 2007, 2009a). Furthermore, each mobile value service was evaluated from the three perspectives of user merit, service provider business merit and cooperating business merit (Yasuoka, 2009b). Yasuoka focuses on and collects examples of mobile value from a comparatively early stage and presents its issues as an application service and the courses of action for their resolution.

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<sup>4</sup>The noncontact IC chip "FeliCa" is one international standard for "Near Field Communication (NFC)" however discussions relating to the robustness of security are outside of the scope of this paper.

<sup>5</sup>The GSM Association, the global industry group for cellular phone corporations and terminal device/transmission equipment manufacturers is attempting to standardize electronic payments regarding cellular phones for "The 'Pay-BuyMobile' initiative". The Japanese NTT Docomo and the Korean KT are participating in the same initiative.

In the above manner, several examples exist within Japan whereby research is not limited to simple examples and a more in-depth analysis is carried out. However, none of the research treats the development of the distribution platform for this electronic value into a cooperative network of value exchange in which 164 varieties of mobile value exist.

### 3. Analysis of the Status of Mobile Value Exchange Partnership Networks

#### 3.1. Small World

The vertically integrated business scheme whereby cellular phones mounted with noncontact IC chips for the provision of mobile value, the communication lines of the cellular phone businesses, the certificate authority for the platform and the application services are all provided by different businesses is probably uncommon in the world. However an approach separating mobile value into electronic money and corporate points, furthermore classifying the services and discussing their characteristics cannot grasp the whole picture. Furthermore even if individual services were evaluated in detail, the stimulating influence had by the reciprocal exchange and cooperation between mobile value services in the network environment could not be overlooked. Consequently, by first treating the horizontal specialization-type service scheme itself in which mobile value is mutually associated, it becomes possible to grasp the total social system from both the side of the vertical connections considered in prior research and the horizontal specialization considered in this research. For this purpose an approach treating the horizontal specialization-type service scheme is necessary.



**Fig. 1 Partnership Networks for Exchange of Mobile Value (February 2007 - January 2010)**

This research utilises data owned by the website “Poitan”, which provides information regarding the above-mentioned value exchanges and generates a network of the total exchange partnerships based on social network theory. Specifically this research depicts the total of these electronic value exchange partnerships by a network of mobile value services

as nodes and the exchange partnership alliances as links and analyses their characteristics. Fig. 1 is a network constructed by the 155 from within 164 varieties of service registered with “Poitan” that formed some kind of partnership of value exchange throughout the period from February 2007 to January 2010. With the clustering factor of this network at 0.428 and an average path length of 2.848 this is a small-world network simultaneously realising a relatively high a clustering factor and short average path length. As information circulation is generally carried out actively in small-world networks it can be said that this is a network structure suitable for the exchange of mobile value.

### 3. 2. Scale Free

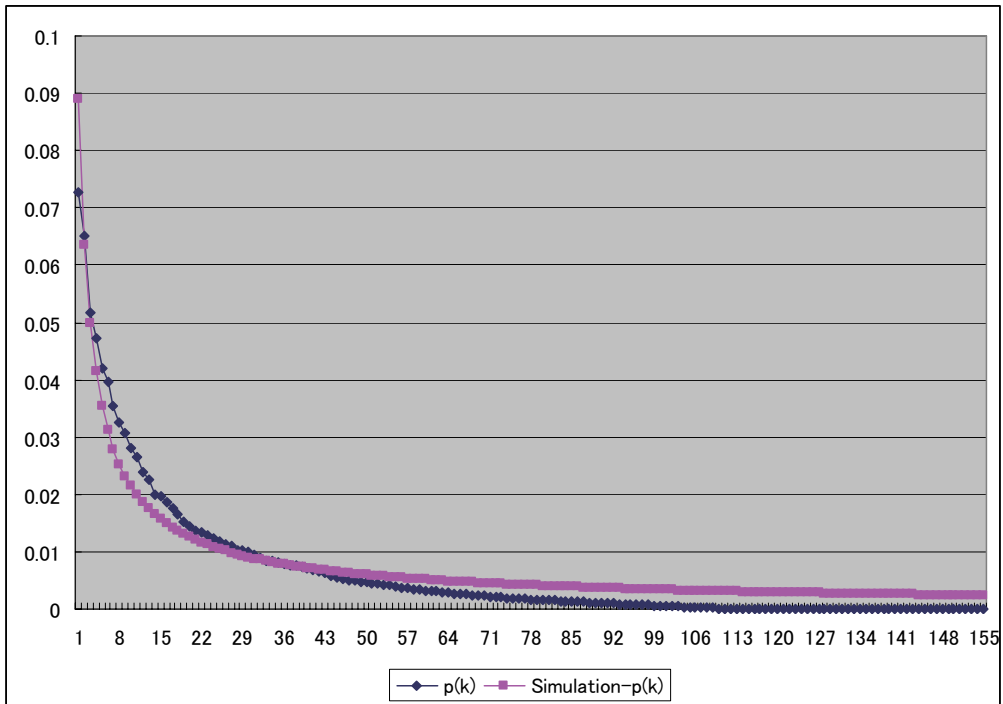
If, for example, the same exchange partnerships are concluded for all kinds of mobile value, the distribution of the links the nodes have becomes constant. However in cases such as when a specific business gains advantage the distribution of the link count becomes extremely biased. It is known that social phenomena which obey power laws exist in great numbers. The distribution of link counts possessed by nodes frequently follows a power law, particularly in the case where a competitive environment is expressed in a network. Power law distributed social phenomena signify the possession of a scale free characteristic that does not have a typical value representing the distribution of the whole, with a large power index expressing a high degree of inequality within the social phenomenon (in other words, a higher power index is a situation closer to a monopoly). Networks that possess this kind of characteristic are called “scale-free networks”.

Let  $k$  be the link count each node possesses (the number of exchange partnerships) in the network. Then consider the link count for each node to be distributed according to the probability density  $\{ p(k) \} = \{ p(0), p(1), p(2), \dots \}$ . The power law link count distribution is displayed by Formula 1, where  $\gamma$  is the power index.

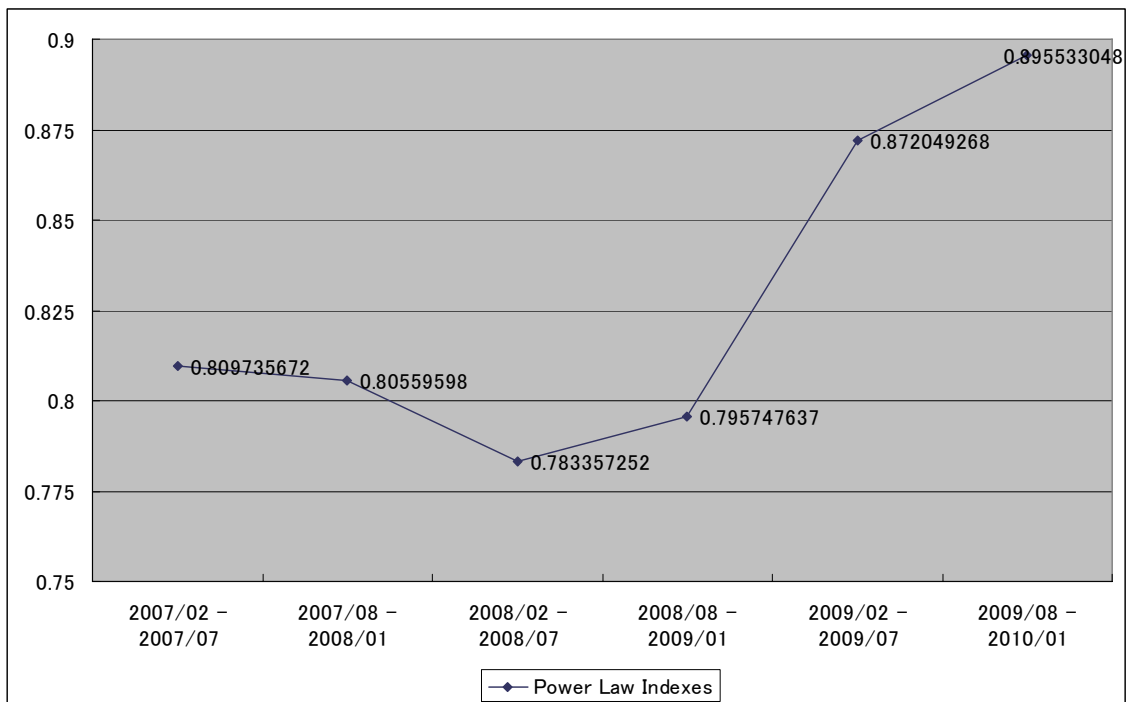
$$p(k) \propto k^{-\gamma} \quad (\text{Formula 1})$$

Fig 2 is a graph for the mobile value exchange partnership networks of the entire period (February 2007 - January 2010) arranging the accumulation of mobile value on the horizontal axis and link count distribution  $p(k)$  along with a Simulation- $p(k)$  by least-squares method on the vertical axis. The power index obtained for the entire period was 0.835.

Albert et al. Discovered that Internet links also follow a “power law distribution” (Albert et al., 2000). According to Albert, the network of hyperlinks that treats websites as nodes displayed a power index of value 1.9 to 2.7 for the link count distribution. Albert also says that when the routers for the Internet are taken as nodes and the physical network wiring considered as links, the power index is a value from 2.1 to 2.5. In comparison with the Internet it was established that there was no clear distinction between the strong and weak players in the partnership network for exchange of mobile value, although it did possess a scale free quality. It is conceivable that this is because the entity of mobile value consists of “currencies” of differing reliability and versatility such as electronic money and corporate points such that it is difficult to produce circumstances whereby one in particular is extracted from the mobile value service to become predominant.



**Fig. 2 Degree Distribution for Mobile Value Exchange Partnership Networks (February 2007 - January 2010)**



**Fig. 3 Power Index Transitions for Mobile Value Exchange Partnership Networks**

Furthermore, it was confirmed in what way the exchange partnership network for mobile value forms alliances and grows in chronological order. The treated node count was fixed at the 155 varieties that entered into some kind of exchange partnership throughout the entire period and whether the individual cooperative business partnerships or cancellation of cooperation caused a change in the structure of the network as a whole was treated by the power index. Using the above method to estimate the power index by the least-squares method, a power index was calculated from the mobile value exchange partnership network created from "Poitan" data at six month intervals. The series transition at that time is as Fig. 3.

Although the power index temporarily drops in 2008, the chronological transition is in an upward tendency from the start of 2009. Although mobile values were fixed at 155 varieties, this is no great issue as the variation in power index is usually caused by the commencement of exchange partnerships or partnership cancellation as there are few entries into or withdrawals from this service. Consequently, the most recent situation can be interpreted as one whereby exchange partnerships within the network for the central mobile value services are continuing to be aggregated. However, we cannot sufficiently confirm whether this tendency is invariable or not without accumulating more data.

## **4. Evaluation Model for Social System**

### **4. 1. Value Exchange System**

In the preceding section, we discussed overall tendencies in the actual state of mobile value exchange partnership. However, we did not evaluate the mobile value exchange alliance as a social system. Therefore, we discuss the framework of analysis, taking a certain issue as an example. Yuhashi pointed out the existence of a channel through which people can obtain a first class air ticket from Narita to London worth 1,946,100 yen at the price of about 250,000 yen by utilizing the mobile value exchange partnership network (Yuhashi, 2008). To be specific, purchase "Web Money" worth 252,000 yen and exchange it with 240,000 "Rakuten Points" (requiring commission fee). Then, exchange the "Rakuten Points" with "ANA Mileage," equivalent to 120,000 miles which can be used for a first class air ticket.

In fact, since the terms of service for "Rakuten Points" include a rule that points of other mobile values obtained through the exchange partnerships should be used only at Shopping Mall "Rakuten", you cannot obtain a first class air ticket utilizing the above channel. However, we have a sense of danger about the fact that only one rule in the terms of service prevent a channel which produces an alchemy.

While the system of electronic money is a linear value system where one point is worth one yen, and the worth of 1,000 points is 1000 yen, the mileage service of airline companies is not a linear value system. In this system, when mileage accumulates, added values increase at an accelerating pace. Specifically, the mileage system is a value system of quadratic curve, where the worth of one mile is one yen and that of 1000 miles is 3,000 yen.

On the other hand, many corporate points do not guarantee monetary value unlike electronic money. Companies control the value system at their discretion. Furthermore, clear standards for exchange partnerships do not exist, and exchange rates are determined by negotiation among company partnerships. In other words, companies offering mobile value provide service in the autonomous-decentralized way, setting suboptimal exchange conditions of mobile values to form or cancel partnership. Under such environment, discovery of channel which can be actually used for the similar cases of an air ticket described above leads to instant movement of the vast amount of electronic value, followed by the local collapse of value system for each mobile value service. If necessary countermeasures are not taken on time, credibility of the electronic value distribution platform may also collapse.

A wide variety of mobile value and exchange of mobile value through partnerships among companies mean great convenience for consumers, but at the same time mean risk that

local collapse of value system may cause the collapse of credibility of the whole social system. Therefore, after fully understanding the situation where mobile value services existing in the autonomous-decentralized way influence each other, we have to clarify points where potential risks exist in the social system in order to keep the social system functioning adequately. The study by Yasutomi provides a clue for framework to evaluate potential risks existing in the social system (Yasutomi, 2000).

Yasutomi proposes “hypothesis of qualitative purchasing power” which explains disparity of monetary value in the international market from the viewpoint of diversity of goods/services exchangeable with money. Different from Krugman’s model explaining wage disparity between developed countries and developing countries from the viewpoint of commodity diversity (Krugman et al., 1979), in the basic model of the hypothesis of qualitative purchasing power, the labor quality in developed countries is equal to that in developing countries and not labor but money of countries is subject to evaluate in the international market. For example, Country A produces  $m$  kinds of goods/services and Country B produces  $n$  kinds of goods/services ( $m > n$ ). When the value of labor in one unit equals to one unit of money in each country, the money exchange rate of Country A and Country B can be represented as A yen of 1 unit = B yen of  $r$  unit. Then repeated production of goods/services domestically and repeated consumption of goods/services of the other country (including currency exchange) by the people in both countries move the exchange rate  $r$ . The differential equation is the following Formula 2.

$$r' = \frac{m}{m+n} \cdot \frac{1}{r} - \frac{n}{m+n} \cdot 1 \quad (\text{Formula 2})$$

From Formula 2,  $r^*$  which is the value when  $r$  becomes stable after repeating transaction is simplified into the Formula 3.

$$r^* = \frac{m}{n} \quad (\text{Formula 3})$$

Yasutomi introduced the concept of nontradable commodity in good/services and population to expand the model by adding export promoting effect due to decrease in monetary value. However, various data from actual social phenomena is not available when applying this model to the mobile value exchange partnership network. Therefore, adoption of the basic model is adequate. The essential issue is how to address the concept of diversity.

## 4. 2. Diversity

When mobile value is used for goods/services, goods/services prepared in the service do not necessarily have diversity. Although mileage service of airline companies can be basically used to the reservation of seats and upgraded seats, the service does not have variety of goods/services. The system maintains versatility, complementing diversity by forming partnership to exchange mileage with various mobile values utilizing its value as expensive air tickets in terms of monetary value.

Therefore, we propose the introduction of Link Assets Closeness Centrality as the index representing diversity of mobile value service. Hereinafter, the number of views of Web pages introducing each mobile value service within “Poitan” Web site (Page Views) is referred to as “the number of virtual users” of mobile virtual service. The number of searches for point search in “Poitan” (the search function for conditions to exchange owned mobile values to other mobile value) is considered as “virtual exchange flow” between mobile value services to adopt the value.

In the social network theory, “Closeness Centrality” is the index showing the position of a

node in terms of easy connection to other nodes in the network. Closeness Centrality is obtained by dividing the summation of the closest link in node pair within the network by the summation of the shortest path length between the target node and other nodes. High value of Closeness Centrality indicates the central positioning, meaning the ability to connect to other nodes with a fewer links. Since we pay attention to mobile value exchange partnerships, we change the index of centrality focusing on nodes to the index of centrality focusing on links. That is, the summation of links between nodes (total number of links) is divided by the summation of the shortest path length from the target link to all links within the network. We define it as “Link Closeness Centrality.” We consider that Link Closeness Centrality indicates the degree of exchangeability with various mobile values in the mobile value exchange partnership network.

On the other hand, we consider “the number of virtual users” in the service which is the partner of exchange represent the magnetism of mobile value. Shpiro, et al. suggest that the value of goods/services in the network environment is determined by the number of people connecting to the goods/services through the network, and therefore, it is important to create positive feedback of network effect by making good use of relationship formed through the network (Shpiro et al., 1998). In this research, based on Shpiro’s suggestion, “asset value” of mobile value service existing around the target link is considered to be the logarithm of “the number of virtual users” of mobile value services connecting to the target link divided by the logarithm of the summation of “the number of virtual users” of mobile value service. Then, we define the value obtained by multiplying the “Link Closeness Centrality” by “asset value” as “Link Assets Closeness Centrality” (Formula 4).

$$\text{Link Asset Closeness Centrality} = \frac{\text{Total number of links} - 1}{\text{Summation of the shortest path length}} \times \frac{\log(\text{Number of virtual users of services connecting to the target link})}{\log(\text{Summation of “number of virtual users” of all services})}$$

(Formula 4)

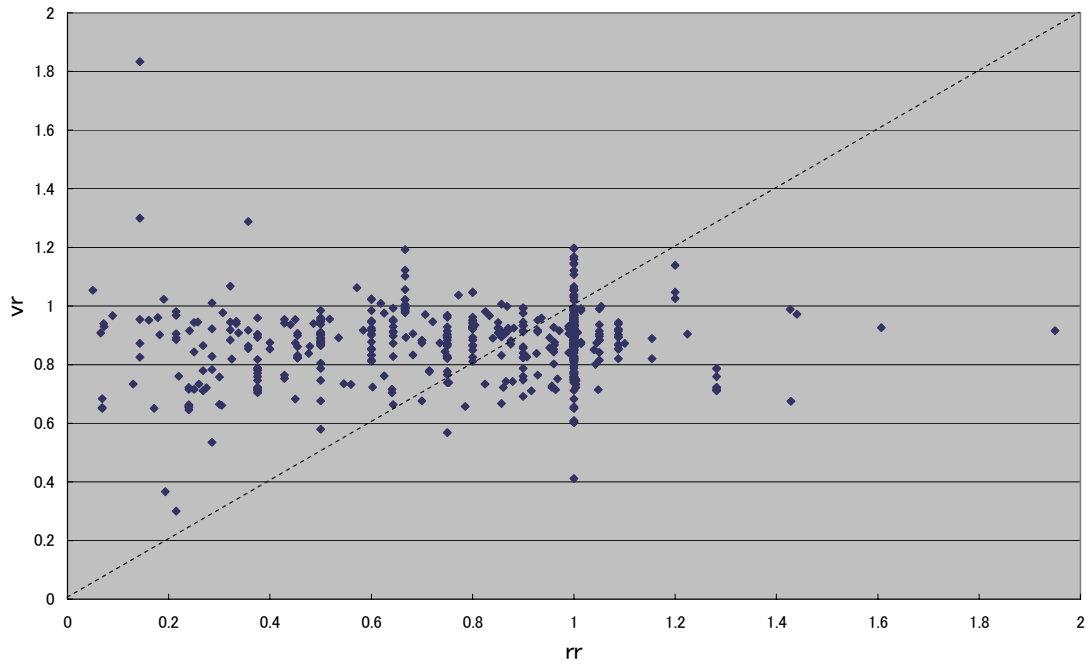
This value represents asset value of exchange partnerships stretching to the periphery of mobile value service. Therefore, we consider that adding asset value of surrounding links for each mobile value can represent the diversity of the mobile value service (hereinafter referred to as “virtual diversity”). Then the virtual diversity is considered as the diversity  $m, n$  of goods/services in “hypothesis of qualitative purchasing power” to obtain virtual exchange rate in each exchange partnership. By obtaining the difference between the actual exchange rate determined by exchange partnerships and the virtual exchange rate, we can evaluate exchange partnerships.

In particular, it is desirable that the virtual exchange rate calculated based on the above model discussed corresponds with the actual exchange rate to avoid local collapse of value system in the mobile value exchange network. However, mobile value exchange partnerships deviating sharply from the corresponding points are considered to have a channel which conducts unbalanced exchanges of values, having potential risks. We propose the discussion regarding the credibility of social system as an evaluation model.

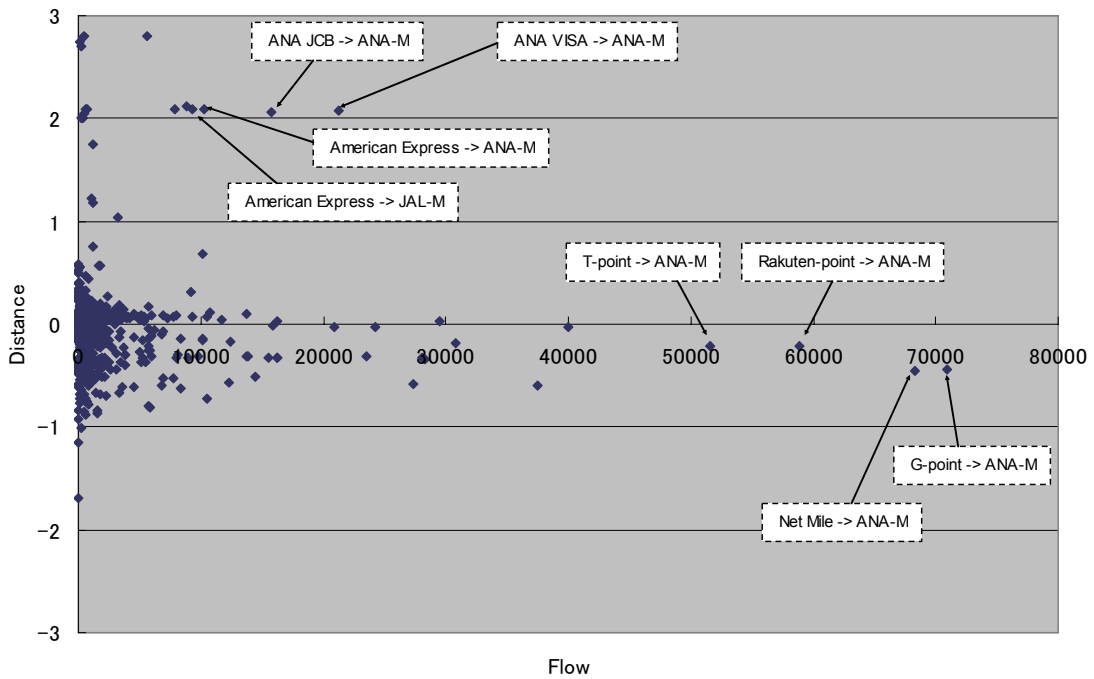
## 5. Case verification of the evaluation model

Fig. 4 shows exchange alliances using the above mentioned evaluation model. It is plotted with the real exchange rate  $rr$  (actually fixed for the exchange partnership) as the horizontal axis and virtual exchange rate  $vr$  as the vertical axis. Little alliance can be seen on the “ $rr = vr$ ” line. As a whole, virtual exchange rate  $vr$  seems to have a greater tendency to be high rather than the real exchange rate  $rr$  (actually fixed for exchange partnership.) In addition, most of the real exchange rate  $rr$  values tend to be around 1, though it is assumed that exchange rates are fixed as a result of business negotiation without any specific ground

for calculation or evaluation against exchange rates fixed for exchange partnership.



**Fig. 4** Distribution of exchange partnership regarding virtual exchange rate  $vr$  and real exchange rate  $rr$



**Fig. 5** Distribution of exchange partnership regarding divergence with the evaluation model and circulation amount

We found that a large number of exchange partnership has potential risks. However, we need to consider the volume of mobile values if we are to discuss the significance of such partnership. Fig. 5 shows each partnership, plotted with the distance between each partnership in Fig. 4 and the “ $rr = vr$ ” line as the vertical axis (positive quadrant in case of  $rr > vr$  and negative quadrant in case of  $rr < vr$ ), and “virtual exchange flow” as the horizontal axis.

Fig. 5 shows a general tendency where a divergence between the virtual exchange rate  $vr$  and the real exchange rate  $rr$  gets smaller as the amount of circulation increases. This means that most of the widely circulated exchange partnerships deal with trouble-free  $rr$  and there seems to be no such event as is necessary to be handled as soon as possible. However, on the upper part of the plot chart, values of virtual exchange rate  $vr$  are larger than those of the real exchange rate  $rr$ , which represents partnership for exchanging credit card point service with airline mileage service. We assume this is due to a strategy developed by credit card companies targeting business persons of frequent airline users, leading them to exchange mileage service with much advantage than market rate. It is highly possible that such benefits will locally invite business success. However, because of constantly imbalanced exchange rate, such benefits may affect reliability of the whole platforms where e-values are circulated. We need to carefully watch exchange alliances having potential risks, wide circulation and huge impacts.

## 6. Conclusion

Kokuryo defines a business where various enterprises develop schemes for vertical integration and horizontal specialization as a platform. He suggests that the platform needs to have functions including provision of reliability, assessment of economic value and standard transaction procedures in order to create a new value by integrating various information or data obtained from the enterprises participating in the business (Kokuryo, 1999.)

Business environment where mobile values are widely circulated is indeed a platform for huge vertical integration / horizontal specialization. Most of the previous studies have dealt with mobile values as an example of a model for vertical integration, while this research has become the first to properly evaluate mobile values as a model for horizontal specialization. As a result, this research proposes a model for evaluating ensured reliability against mobile values constantly changing via exchange partnership. This evaluation model enables us to figure out potential risks and the size of their impacts and will serve as a tool for recognizing and analyzing any situation expected in order to operate social systems.

In this research, circulation of mobile values is referred as an event limited between two services. However, in the future network environment, it is assumed that wide circulation of surrounding exchange partnership may affect another partnership. Therefore, we need to separately consider influence on networks caused by circulation of mobile values.

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