

Reframing the Concept of Collection Systems with Economic Incentives

- Based on the Review of Deposit-Refund Systems and Point Systems -

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English Summary

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Summary

This research sought to revisit and analyze measures which aim to promote collection of recyclables and waste with the provision of economic incentives. As existing examples of such measures, we examined various aspects of deposit-refund systems and reward points collection systems from both theoretical and practical viewpoints

In Chapter 1, we stated the background and aims of this study and categorized various types of collection systems with economic incentives (see Table 1). The characteristics of deposit-refund systems and reward points collection systems, the focus of this research, were highlighted.

Table 1. Types of collection systems with economic incentives based on characteristics of incentives

Flow of economic incentives (e.g. money, points)		Example of systems *Texts in the parentheses show transfer of economic incentives	Outline of the system
One-way	Incentive provider ↓ Returner	Subsidy for citizen group collection (Local government → Citizen group)	An incentive provider gives an economic reward to the returner of an object.
Two-way	Returner ↓ Incentive provider ↓ Returner	Deposit-refund systems (Consumer → Retailer → Consumer)	An incentive provider collect a deposit from a person who obtains an object that should be collected, and pay back the deposit to him/her when the object is returned.
	Incentive provider ↓ Returner ↓ Incentive provider	Reward points collection systems (Retailer → Consumer → Retailer)	An incentive provider give points or other forms of economic rewards to a person who returns an object that should be collected. The returner can use the points for buying products and services sold by the point provider.

* Collection systems without economic incentives includes, among others: station collection; curbside collection; pick-up collection at each household; collection of bulky waste which often requires prior notification and payment by the generator; collection using a parcel delivery (which is applied for collection of waste person computer under Act for Promotion of Effective Utilization of Resources in Japan), collection at designated collection sites including shops; collection organized at specific events; and citizen group collection. In some cases, collection at designated collection sites and collection organized at events involves provision of economic incentives, and citizen group collection often receives subsidies from local governments in Japan.

In Chapter 2, we summarized the potential advantages, barriers as well as improvement measures for deposit-refund systems found in existing research on deposit-refund systems in the field of economics. Existing literature suggested that deposit-refund systems had several advantages such as its effectiveness in increasing collection of items covered by the system and smaller need to secure additional financial resources (see Table 2). Meanwhile, the literature also pointed to various challenges related to their implementation (see Table 3). These challenges indicated that deposit-refund systems required careful design consideration on a number of issues, such as items covered by a deposit-refund system, the size of deposit and refund, identifiability of the items, flows of materials and money, handling of unredeemed deposits, taxation on deposits, accounting system, handling fee for retailers, cost of managing a deposit-refund system, and the like.

Table 2. Potential advantages of deposit-refund systems

(1) Maximizing social welfare
(2) Effective monitoring system
(3) Environmental benefits
(a) Increase in collection rate
(b) Promotion of recycling and reuse, contribution to resource efficiency
(c) Reduction of waste, landfill, and illegal dumping
(4) Others
(a) Additional source of income especially for people with low incomes
(b) Less budget required for collection
(c) Use of unredeemed deposits for replacing uncollected products
(d) Raising environmental awareness
(e) Increase in the total number of employment

Table 3. Potential Barriers of introducing and implementing deposit-refund systems

(1) Burden on retailers for collection, storage and treatment of collected objects
(2) Burden for establishing a mechanism for collection of deposit and provision of refund
(3) Disputes over the use of unredeemed deposit
(4) Decrease in sales of the products covered by deposit refund systems
(5) Negative influence on existing collection systems
(6) Concerns over claiming refund without paying deposit and/or a shift of sales of products in areas not covered by a deposit-refund system
(7) Implementation issues (e.g. who does what, financial mechanisms, and monitoring and penalty against non-compliance and fraud)
(8) Others
(a) Hindrance of reuse by household members
(b) Sanitary issues
(c) Loss of employment in manufacturing of products affected by deposit-refund systems
(d) Inducement of environmentally-inappropriate consumption when the scope of product items is inappropriate
(e) Additional energy use

Chapter 3 started with a summary of our investigation on existing deposit-refund systems outside Japan, including the sources of information for the respective systems. Our investigation indicated that a variety of items had been covered by what was considered as a deposit-refund system (see Table 4). While many of the targeted items were beverage containers, other items such as batteries, containers for hazardous substances, cars, tires, waste oils, electrical and electronic equipment, lamps and fluorescent lights had been also covered by deposit refund systems. Application of the tax reimbursement system was identified in the case of CFCs (chlorofluorocarbons). Based on the overview, we subsequently selected and looked into the implementation practice of the following five systems in greater details: deposit-refund systems for beverage containers in Sweden and Germany, for fluorescent lights and lamps in Austria, for pesticides in the State of Maine in the United States, and a tax reimbursement system for trichloroethylene and CFCs in Norway. The review of the five systems helped us identify a number of measures to ease the introduction of the systems as well as their implementation. Aims of these measures included limitation of items covered in the system, reduction of handling procedures, strengthening of source separation, collection and appropriate treatment and disposal, reduction of industries' opposition, and enhancement of the comprehensibility of the system (see Table 5).

Table 4 Objects of mandatory deposit-refund systems outside Japan

Object of deposit-refund systems	No. of mandatory systems	
	Number of systems whose existence were confirmed (Figures in parenthesis shows no. of systems that were abolished)	Number of systems referred to in literature but whose existence cannot be confirmed
Drink containers	43 (2)	23
Batteries	13 (2)	8
Cars	3 (1)	3
Tires	3 (1)	3
Toxic chemical containers	2 (1)	4
CFCs	0 (0)	5
Oil waste	1 (1)	3
Chemicals	0 (0)	4
Packaging	0 (0)	4
Electronics	2 (2)	1
Glass	0 (0)	3
Plastics	1 (1)	1
Paper	1 (1)	1
Metals	1 (1)	1
Lamps and fluorescent lights	1 (1)	0
Others	0 (0)	2

Table 5 Improvement measures to cope with the barriers in Table 3.

<p><i>(Limit items covered in the system)</i></p> <ul style="list-style-type: none"> - Non-provision of refund when the number of returned items exceeds a certain level (Austria) - Exemption of large containers (Germany) <p><i>(Reduce handling procedure)</i></p> <ul style="list-style-type: none"> - Omit the procedures of deposit and refund when returning the object with the purchase of the same object (Austria) - Use of reverse vending machines (Sweden and Germany) - Minimum quantity required for return (Norway) <p><i>(Strengthen collection)</i></p> <ul style="list-style-type: none"> - Returners do not have to pay disposal cost for the return of up to three items (Austria) <p><i>(Increase consumers' convenience)</i></p> <ul style="list-style-type: none"> - Enabling consumers to return products to any retailer that sells the same type of products (Sweden and Germany) <p><i>(Increase distinguishability of items)</i></p> <ul style="list-style-type: none"> - Use of bar codes (Sweden and Germany) <p><i>(Strengthen source separation)</i></p> <ul style="list-style-type: none"> - Attachment of a written pledge (US-Maine) <p><i>(Reduce opposition of private actors & enhance appropriate treatment)</i></p> <ul style="list-style-type: none"> - Payment of handling fee to retailers, etc. (Sweden and Norway) - Half of deposit is used for disposal of collected objects (Norway) <p><i>(Enhance comprehensibility of the system)</i></p> <ul style="list-style-type: none"> - Making the scope of items easy to understand (Germany) - Uniformed size of deposit (Germany)
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In Chapter 4, based on the review in the previous chapters, we sought to reframe the concepts of deposit-refund systems, the core subject of this report. First, we provided a categorization of deposit-refund systems based on the objects of the systems – an approach unique to this report. Deposit-refund systems were divided into five categories: deposit-refund system for waste; for valuables; for items useful for their providers (reusables); for items whose providers wished to collect them once the items became unuseful for their users; and for items containing hazardous substances (toxics). The main features of the respective categories identified were as follows (also, see Table 6).

- A deposit-refund system for waste would be introduced primarily to prevent littering. It is important to secure the disposal cost of collected waste.
- A deposit-refund system for valuables is considered to have a higher applicability when the price of valuables is not high and whose littering is of concern; in cases where the prices of valuables are sufficiently high, voluntary collection via purchase would prevail (i.e. collection is taken care of under normal market mechanism). If an actor seeks to continue to collect the valuables under the deposit-refund system, it is therefore important to be aware of the potential for the changes in the price of valuables.
- Under the deposit-refund systems for reusables and for items whose providers wish to collect, collection of these items is of the interest of their providers. These systems are thus often voluntarily organized. However, in cases where externalities exist, social welfare will not be maximized without a government intervention. Even when a government does not intervene, it should formulate minimum rules for business entities regarding deposit-refund systems from the viewpoints of consumer protection as well as of fair handling of deposits and tax payment. Appropriate reporting and auditing of the accounts of deposits should be promoted.
- A deposit-refund system for toxics shares characteristics similar to that on waste. However, as items covered by this system require appropriate treatment, necessity of establishing the system – thus enhancement of collection – is relatively high. Moreover, appropriate handling of products during the collection phase must be ensured.

Table 6 Features of five types of deposit-refund systems based on characteristics of objects of concern

	Deposit-refund system for waste	Deposit-refund system for valuables	Deposit-refund system for items useful for their providers (reusables)	Deposit-refund system for objects whose providers wish to collect	Deposit-refund system for toxics
Object	Objects that are not valuable in market (including objects that are currently disposed of due to their lower value)	Objects that potentially have economic value in market	Objects which are useful for their providers to reuse/utilize	Objects that can cause harm to their providers if not collected	Objects that are harmful to human and the environment (including difficult-to-treat wastes)
Aim	Prevention of littering, avoidance of inappropriate storage and/or separation of waste that contains recyclables.	Promotion of collection and avoidance of dissipation of valuables that are currently not collected under market mechanisms	Ensured collection of objects whose providers can use/utilize	Ensured collection of objects that can do cause harm to their providers if not collected	Prevention of dissipation and appropriate treatment of toxic substances/products/waste (including avoidance of inappropriate storage)
Necessity of establishing object-specific collection systems	Low to High (depends on objects)	Low for valuables alone, but high when combined with other aims such as prevention of disperse and pollution	High	High	Very high
Handling of collected objects	Appropriate disposal, or cyclical use (reuse of parts, recycling, energy recovery)	Cyclical use (reuse, recycling, energy recovery)	Reuse	Appropriate disposal or reuse	Appropriate disposal
Necessity of securing disposal budget	Required	Not required in principle	Not required in principle	Not required in principle	Required

We subsequently examined the basis of determining the size of the refund in the respective categories based on an economic analysis (see Figure 1).

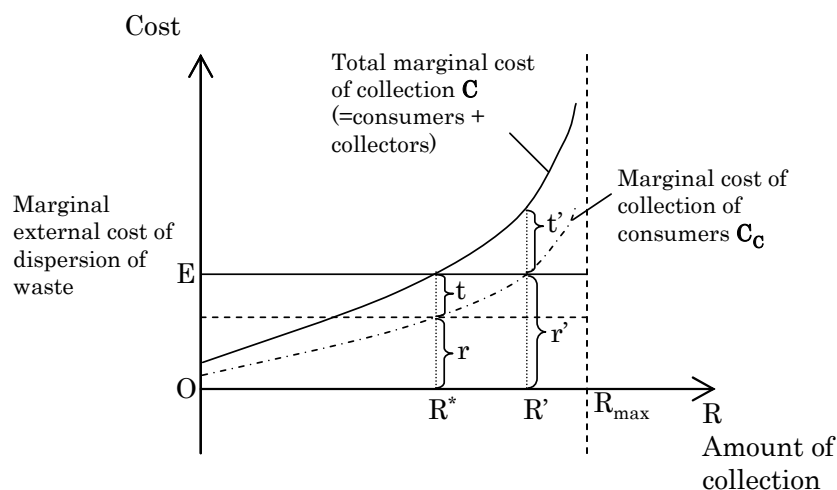


Figure 1 Economic explanation of a deposit-refund system for waste (collection cost of consumers and collectors)

The economic analysis provided several useful insights. First, in principle, the size of the deposit was to be determined so that it would be the same as the marginal external cost of the littering of the items covered by a deposit-refund system. Second, given the financial resources necessary for the collection and treatment of the items, it should be considered natural that the size of the deposit was higher than that of refund. Thirdly, in the case of valuables, it would be necessary to adjust the size of deposit and that of the handling fee for actors involved in collection in order to minimize the overall social cost. Moreover, we indicated and explained the characteristics of three methods of handling unredeemed deposit. We also confirmed that the concepts of 1) polluter pays principle, 2) provision of minimum service by public entities to ensure the inhabitants' basic quality of living (a concept underlying waste policy in Japan) and 3) extended producer responsibility could be applied when considering the payment of collection and treatment cost. The suitability of the respective concepts should be determined case by case considering issues such as the items covered by the respective systems, the potential and necessity of making upstream changes by their producers, and the like.

Furthermore, we recognized four patterns of the flow of items from their producers to consumers - U-turn, J-turn, L-turn and I-turn - and analyzed their characteristics (see Figure 2).

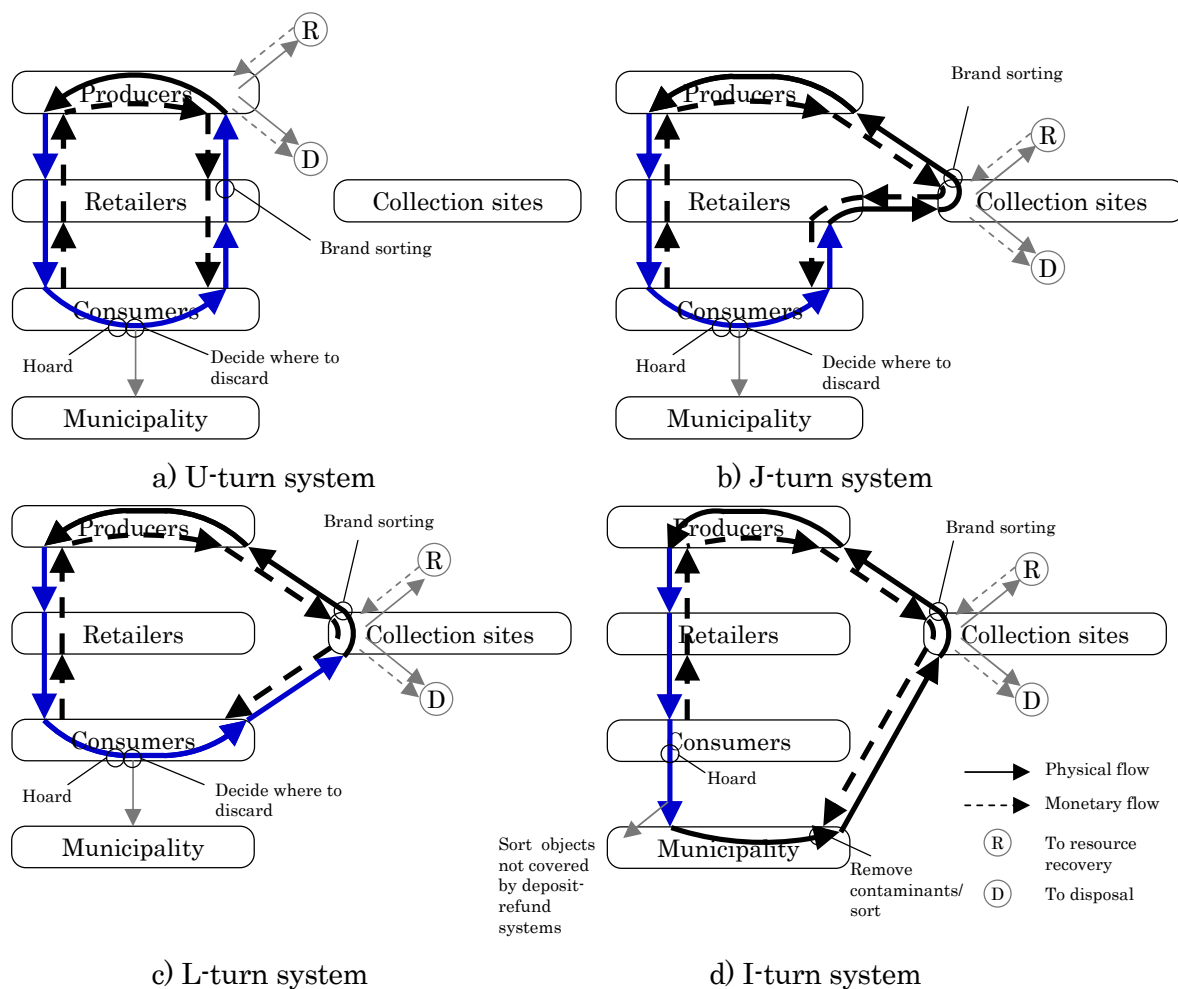


Figure 2 Four types of deposit-refund systems categorized by flows of objects and money

The analysis suggested that there were differences in aspects such as convenience of producers, burden of distributors, necessity of intermediate collection sites and financial mechanisms (see Table 7).

Table 7 Features of four types of deposit-refund systems based on flows of items and money

	U-turn system	J-turn system	L-turn system	I -turn system
Feature	Although retailers' burden is largest, existing collection infrastructure can be used.	Although collection sites must be established, retailers' burden can be reduced.	Although collection sites must be established, retailers' burden can be reduced.	Although retailers' burden is reduced and consumer's convenience is high, economic incentives are small or not given
Consumers' convenience (easiness to return)	Secured to a certain extent (except for complete U-turn systems*)	Secured to a certain extent (except for complete J-turn systems*)	Depends on the number of and proximity to collection sites	High. It is possible to design a system in which consumers do not have to do intensive sorting of all the recyclables. .
Retailers' burden	Largest	Middle	Small (limited to providing related information to consumers only)	Small (limited to providing related information to consumers only)
Sorting of objects when returning to producers	Retailers have to sort objects according to the brands. This burden can be avoided if producers use common items.	Brand sorting not needed. However, it is necessary to distinguish whether the collected item is covered by the systems.	Not required (Done at collection sites)	Not required (Done at collection sites or by a municipality)
Storage space	Required	Required	Not required	Not required
Establishment of collection sites	Not required	Required but the number can be relatively small	Required and the number is supposed to be sufficiently many	Required but the number may be relatively small
Transportation to collection sites	-	Either retailers or operators at collection sites carry out this task.	If frequency of transportation is small, postal/parcel services can be utilized.	Either municipalities or operators at collection sites carry out this task.
Sorting at collection sites*	-	Required	Required	Required

*Complete U-turn/J-turn system: a system in which objects must be returned to the exact place where consumers obtained them.

We discussed six main factors that influence the consumers' behavior of returning items covered by a deposit-refund system as well. These factors were: perception on the necessity to return, attitudes towards the action of returning, economic incentives, characteristics of returned objects, time/trouble for storage, and time/burden required for returning the objects. We analyzed subfactors that influenced the respective six factors (see Figure 3). Similarly, we categorized factors influencing the burden of distributors into six - attitudes towards the action of returning, handling of deposit, acceptance of items from consumers, storage of items, return of items to producers/intermediate

collection sites and information provision to consumers. We analyzed subfactors influencing these six factors and discussed measures to reduce the burden. We further indicated four incentive measures for distributors to return the items to producers and explained their characteristics. We pointed out two different points in the flow of deposit-refund systems where the possibility to distinguish whether an item in question was covered by a deposit refund system. One was when a consumer made a choice of whether to separate an item for a refund system, and the other was when the system accepted and judged whether the refund should be paid to the consumer.

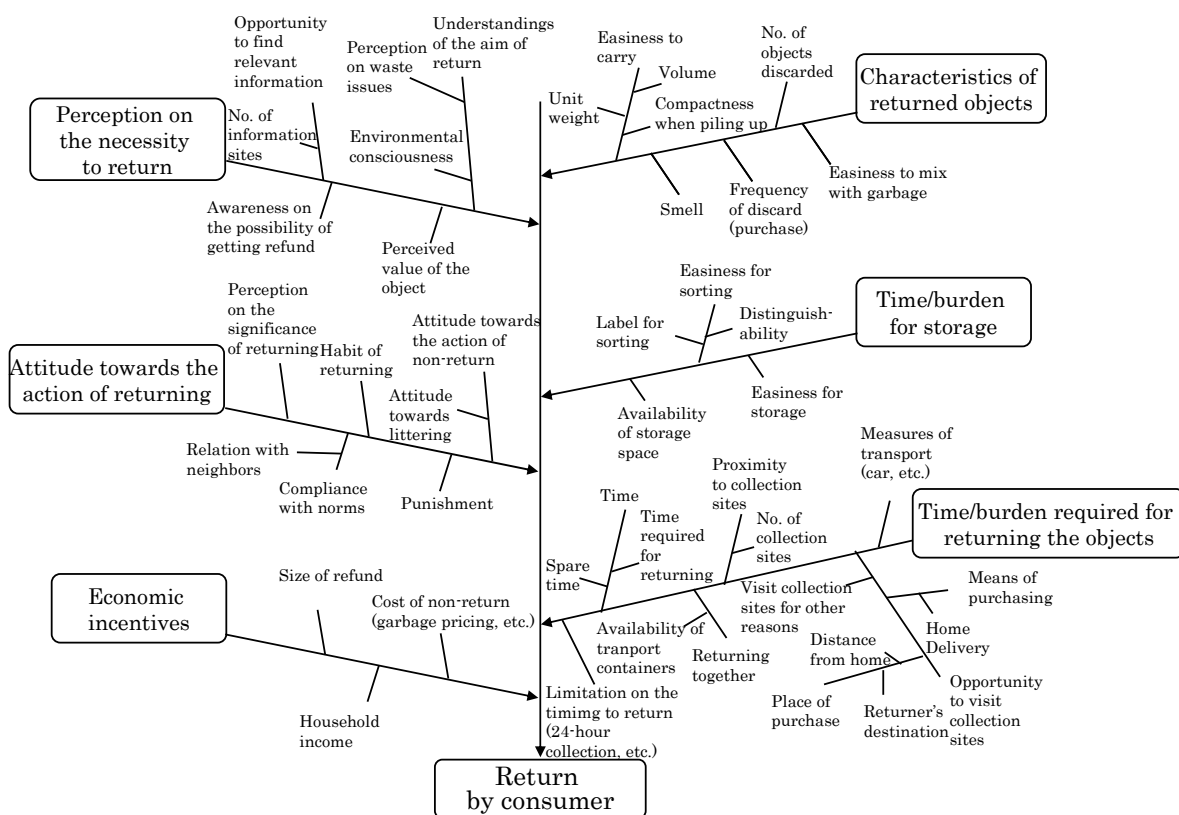


Figure 3 A fish-borne diagram of various factors influencing consumers' behavior on the action of returning items under deposit-refund systems

We further considered a few other aspects of deposit-refund systems. For instance, introduction of a deposit-refund system might enhance the purchase of alternative products/packaging. When purchase of certain items was reduced for reasons such as the size of the deposit and inconvenience for the end-users to hand in the items, producers might be able to regain the sales of the items by improving the collection system. Another aspect considered was the use of unredeemed deposit. The sum of unredeemed deposits accumulated in a deposit-refund system would differ depending on the durability of items upon which a deposit-refund system was introduced – which in turn influenced the length of the period between the purchase and return of the items –, as well as on the return rate (see Figure 4). Existing studies indicated that it was not necessary to monitor the activities of end-users who did not return the items covered under a deposit-refund system, and highlighted this point as an advantage of a deposit-refund system. The system, on the other hand, had a disadvantage of having to monitor those who return, in relation to the possibility of the abuse of the system (i.e. claiming the refund without paying the deposit). However, the disadvantage could be overcome by setting the size of the refund lower than the cost of abusing the system.

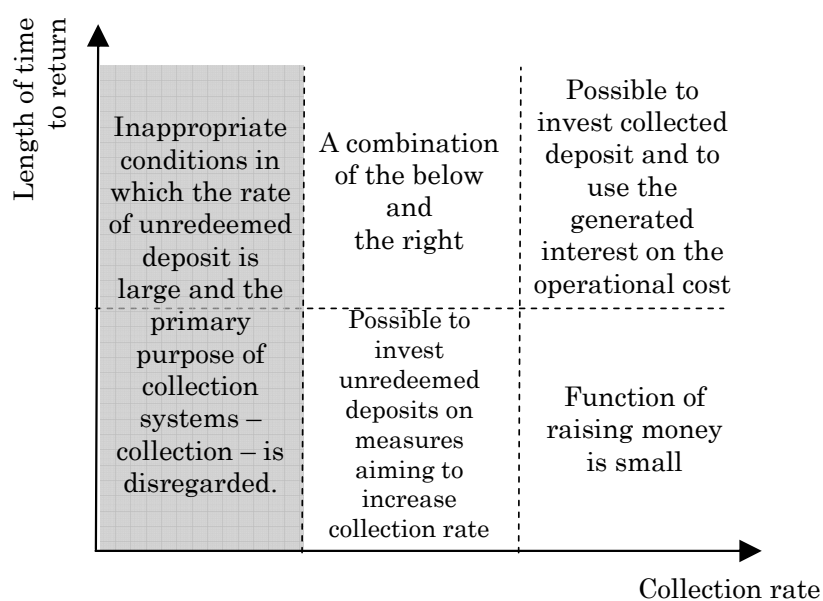


Figure 4 Outline of function of fund raising provided by deposit-refund systems

In addition to deposit-refund systems, we took a look at reward points collection systems, a modification of various reward points systems that private actors had been using to promote the sales of their products (Chapter 5). We considered the reward points collection system as a new variant of collection system that would provide financial incentives to return the targeted items to the appropriate collection sites and analyzed its potential and characteristics. We first reviewed the current status of reward points collection systems as well as its challenges in general, and sought to identify reasons for introducing the reward points collection systems and various measures to overcome the challenges. Empirical studies suggested that the collection rate achieved by the reward points collection system was at least higher than that of the municipal bring-systems (Table 8). We then analyzed the potential and characteristics of reward points collection systems by comparing them with deposit-refund systems and buy-back systems (see Figure 5 and Table 9). We found that the reception/collection of the items under reward points collection systems and deposit-systems tended to become more burdensome than that of buy-back systems. Meanwhile, the range of items that could be subject to the former would be wider than the latter. When comparing deposit-refund systems and reward points collection systems, the range of items that could be subject to the former was larger than the latter. However, resistance of the industry might be lower in the case of the latter. Table 10 shows the summary of features of three different collection systems with economic incentives.

Table 8 Comparison of PET bottles collected by station collection, collection boxes in stores and under a reward points collection system in Adachi Ward, Tokyo, Japan (FY 2009)

	Amount of collection (Tonnes)	Rate of collection (%)	Collection per collection site (kg/site)
Station collection (once a week or twice a month)	1,883	76%	93
Collection at collection boxes in stores	189	8%	794
Collection by reverse vending machines at which points are provided*	403	16%	13,433
Total	2,475	100%	3.7kg/capita/y

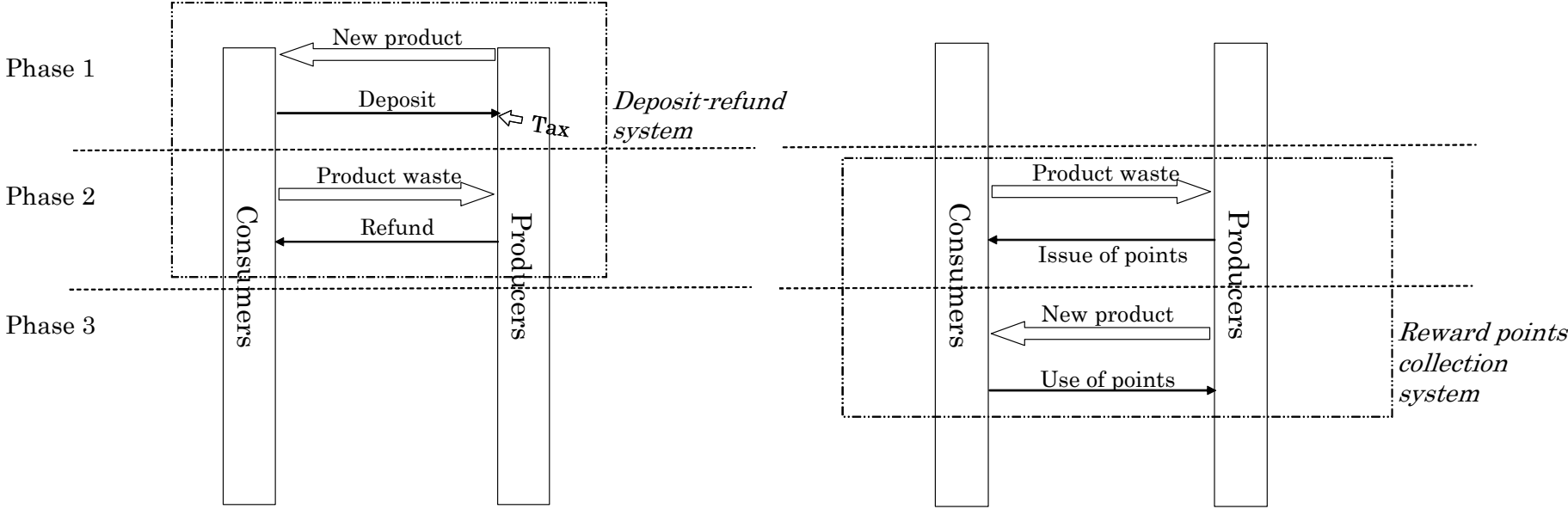


Figure 5 Comparison between deposit-refund system (left) and reward points collection system (right)

Table 9 Comparison between deposit-refund systems, reward points collection systems, and buy-back systems

	Deposit-refund systems	Reward points collection systems	Buy-back systems
Outline	Collect money from a person who obtains an object that should be collected, and pay back the deposit to him/her when the object is returned.	An incentive provider gives points to a person who returns an object that should be collected. The returner can use the points for buying products and services sold by the point provider.	Business entities buy designated objects from consumers who bring them
Burden on incentive providers related to transaction	Large; The two-way interactions that occur at different time require more time and trouble and accounting systems. Introducing specific equipment such as bar code can reduce the burden.		Small; Transaction is one-way and completed each time
Holder of economic incentives (e.g. money)	Business entities	Consumers	- (no one holds)
Criticisms towards unredeemed deposits/unused points	How to deal with unredeemed deposit often raises controversies.	Complaints with unused points rarely heard. Changes in products and services that can be exchanged with points can provoke a criticism.	-
Influence on sales	Decrease in sales is an often-raised concern. Complete U-turn/J-turn Availability of collection points can attract customers.	No influence, or perhaps increase in sales. Systems can be regarded as a tool to enhance customers' loyalty and for differentiation.	Irrelevant. If buy back attracts consumers' attention, it may lead to the increase of sales.
Return to retailers different from the original sellers.	A clearing system is required		Possible without a clearing system
Additional financial resources for the provision of refund/point/buy-back	Not required	Required (Unnecessary if profit margin can make up for it)	Possible to cover the cost with the profit from the sales of collected objects)
Additional financial resources for operation	Possible to source include operational cost collected together with the deposit and unredeemed deposits.		

Table 10 Summary of features of three different collection systems with economic incentives

a) Burden on incentive providers related to transaction Buy-back system < Deposit-refund system = Reward points system
b) Criticisms towards unredeemed deposits/unused points Buy-back system < Reward points system < deposit-refund system
c) Wide applicability of objects to be collected Deposit-refund system > Reward points system > Buy-back system
d) Business entities' incentives to participate in the system Reward points system = Buy-back system > Deposit-refund system

In the last Chapter, we indicated several directions for further research concerning the economic-incentive-based systems that seek to promote source separation and collection of selected items. First, the theoretical analysis of the systems needs to be further developed. Among the five categories of deposit-refund systems and reward points collection systems reviewed in this study, especially insufficient was the theoretical explanation of the reward points collection systems. It would be good to explore the theoretical explanation of the systems, taking into consideration the knowledge related to discount of product price and cases in which the law of one price is not achieved. Existing knowledge related to the significance and efficacy of subsidies for consumers could be also utilized for this endeavor. Regarding deposit-refund systems, this report theoretical explanation envisaged in this report was limited under a static condition. The explanation concerning the process of achieving the optimal condition remained undone. In addition, although this report looked into deposit-refund system for five categories of items separately, some items can have multiple features (e.g. toxic and valuables in reality. Further development of the theoretical discussions for these cases would be needed. We also need to enhance our understanding on why people return recyclables to collection sites even when there is no financial incentive. Identification of the conditions upon which recyclables are returned to collection sites without economic incentives would in turn help clarify the conditions when economic incentives are needed.

Regarding practical application, further consideration should be made on which items should be collected more. A prevailing perception in Japan seemed to be that deposit-refund systems were for beverage containers, but the review presented indicated much broader potential. Application of the deposit-refund systems to other items, such as items containing hazardous substances and valuables, should be included in the

discussion, in addition to returnable PET bottles led by the Japanese Ministry of the Environment. It would require case-by-case analysis concerning who should bear the cost of collection and treatment. Furthermore, on-the-ground investigations is required to understand the reasons why people do not return items to designated collection points even when financial incentives are given to them. A deeper understanding on various limitations facing consumers regarding the return of items as well as characteristics of the items would help devise an effective measure to overcome such limitations. What makes it easy for consumers to return certain items would change over time along with the changes of life style. A deposit-refund system needs adaptation, taking these changes into consideration. Similarly, due attention should be paid on the status of distribution systems. In light of the changes in the selling practices, the importance of exploring incentive-based collection systems that can be easily adapted at places such as convenience stores and large discount shops is increasing than ever.

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