CROSS SUBSIDY POLICY FOR TRANSPORTATION INFRASTRUCTURE INVESTMENT

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Abstract: Though cross subsidy scheme is often criticized on the ground of economic inefficiency it may cause through price distortion, in Japan, it has extensively been used to provide transport infrastructure provisions which would otherwise not be provided due to the lack of financial resources of the government and/or market failure. However, there has not been any systematic assessment covering schemes under different modes in Japan. In this paper, we undertake a brief review of the cross subsidy theory and make an assessment of various cross subsidy schemes adopted in transport infrastructure system in Japan. In the context of growing importance of private financing of infrastructure such as BOT scheme, we have also examined the points of similarity and conflicts between BOT and cross subsidy. Finally, we propose a set of rule to make cross subsidy scheme more effective, and also to make BOT meet the underlying objective of cross subsidy.

1. INTRODUCTION

Cross subsidy (also termed as internal cross subsidy) is a regulatory scheme basically designed to maximize net social benefits. Though its practical applicability and effectiveness have demonstrated a potential for being a useful policy as well as regulatory instrument, its theoretical underpinning has remained somewhat controversial. Various kinds of definitions and concepts have been put forward as attempts to make it theoretically consistent and practically effective.

Okano (1985) has elaborated cross subsidy on the basis of a concept of unremunerative service. He considered cross subsidy as the case where unremunerative service is duely compensated by the profit of other services. Unremunerative service is defined as "a service, or part of a service, the resulting revenues from which are known (or definitely expected) to be insufficient to cover those costs which, but for its provision, would not have been incurred, either directly or indirectly, in the short or long run" (Ponsonby 1963). To put simply, unrenumerative services are unpaid but useful services for some users. However, services like developmental service, off-peak service, back loading, feeder service and common costs do not fall in this category. The economic theory argues for a subsidy-free pricing system to ensure a maximum efficiency in the economic system (Faulhaber 1975, Faulhaber et al. 1981).

On the basic level, a subsidy can be seen as a measure that internalizes the external effects of a service into its price. If the external effect is positive, the service would be a candidate for receiving subsidies while the service with negative external effects (or receiver of positive external effects of other service) would be required to provide subsidies (Button 1993). When such compensation of externality is confined within a sector, mode or any other regime under a single institutional jurisdiction, the subsidy is termed as cross subsidy. In practice, the cross subsidy as a concept is very wide covering different objectives, sectors or target groups. Often, cross subsidy is interpreted as a governmental

measure to transfer the cost burden from poorer user group to richer group and it is criticized as possible source of inefficiency (e.g. Chujo 1992). But, the central issue that we want to highlight in this paper is somewhat different from such a simplistic notion of cross subsidy. Our main focus is to examine the effectiveness of cross subsidies in the process of transport infrastructure investment. Hence, we make an attempt to redefine the purpose of cross subsidies in the context of transport infrastructure investment, which may have broader social goals than the narrowly defined objectives of cross subsidy.

The importance of cross subsidy scheme in transport infrastructure investment in Japan can be perhaps better understood in the context of various special institutional provisions set up for the purpose of transportation network development. Most important feature of the strategy adopted in Japan is the cost recovery approach in construction and operation of transport infrastructure facility as opposed to the financing from the general taxation. Arrangements have been made to price the transport service on the basis of users pay principle to the extent it does not violate other underlying objectives (Morichi (ed.) 1991). The cost recovery approach which might appear fair on the basis of economic principles however does not serve the intended purpose always. For instance, it is a common experience that over the time the unit cost of infrastructure construction goes up due to increasing land price, need of intersection structure and irregular right-of-way. That makes the fare level in posterior route much higher than that in prior route even though the service level and technical efficiency are the same (Japan Highway Public Corporation 1998). So, if the posterior route is required to stand on its own to recover the cost, either a socially unjustifiable high price need to be imposed on posterior users (with possible loss in social efficiency by under utilization of the capacity) or the route, (which is technically or socially desirable) would not be constructed. In such a situation, transfer of a part of cost-burden of posterior route to the users of prior route can well justified through the cross subsidy schemes.

Thus, the case of Japan might serve as a useful lesson for developing countries where lack of financial resources in government budgetary system has placed a severe constraint on the development of transport infrastructure, which the countries are desperately in need of to drive economic growth (Hayashi et al. 1995). Particularly, the cost recovery approach along with cross subsidies mechanism might open a new avenue to institute a system of revenue collection on user-pay-principle, also partly solving the chronic problem of tax evasion. Further, historical account suggests that, over the time, the institutional set-up in transport infrastructure sector has fluctuated between two extremes of public domination and private sector domination (Gomez-Ibanez and Meyer 1993) as shown in Figure 1. The shift from one institutional arrangement to another obviously incurs a significant cost to the society. So there is a need to devise a more lasting institutional set-up based on a balanced partnership of public-private sector. It is our understanding that the experience of Japanese institutional system with in-built cross subsidy mechanism could provide a useful guidance toward developing such system.

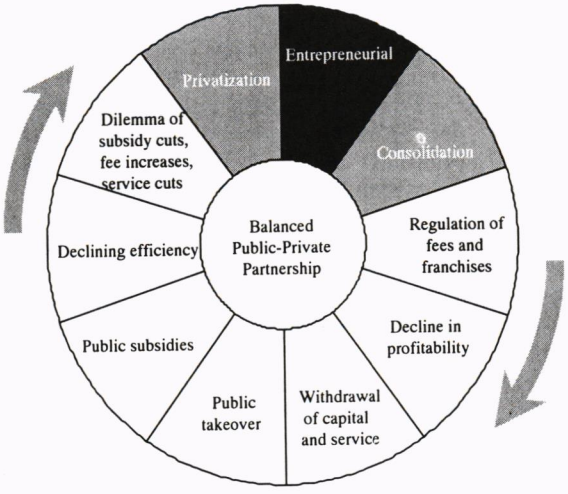

Figure 1. The privatization-nationalization wheel

With this backdrop, this paper attempts to carry a systematic assessment of cross subsidy schemes adopted in various transportation infrastructure undertakings in Japan. In Chapter 2, a discussion on the controversies of cross subsidy from the viewpoints of various stakeholders is presented. Chapter 3 briefly appraises various transport infrastructure schemes with cross subsidy, few examples of schemes without cross subsides, problem associated in applying cross-subsides mechanism, a simulation exercise to examine the effect of cross subsidy on total generalized cost and recommends a set of broad guidelines to make improvement. This is followed by Chapter 4 with a discussion on the role of private sector in transport infrastructure investment and possibility of accommodating cross subsidy schemes in private sector involved undertakings including BOT. Finally conclusion is drawn in Chapter 5.

2. CONTROVERSY OF CROSS SUBSIDY IN TRANSPORT INFRASTRUCTURE

There have been many transportation infrastructure facilities built and/or operated under cross subsidy scheme. Cross subsidy is often depicted as a source of economic inefficiency on one hand and, a corrective-measure to deliver a useful service (which would otherwise have not been provided through market mechanism due to the lack of financial resources of the government and/or market failure) on the other hand. In effect, cross subsidy mechanism transfers a part of cost burden between undertakings, different routes under a same undertaking or between users. So it has a direct impact on an undertaking's profit level or/and user's welfare. As the implementation criteria of cross subsidy scheme involve considerable degree of subjective judgement, it invites an endless debate on fairness and efficiency of the scheme.

Table 1. Summary of Controversy of Cross subsidy in Transport Infrastructure

Broad objectives			Equality in users' benefit		Getting rid of bottleneck		Minimization of risk		Expedite economic growth
Specific objectives			Compensation in a steep rise of construction cost	Income distribution	Efficiency in collecting toll /fare	Reduction of congestion by supplemental route provision	Risk taking by side business	To facilitate financing and reduce risks	Expedite construction
Conflict between stakeholders	Users	Subsidy providing users	Prior facility users	Prior facility users	Congested facility users	Congested facility users	Transport facility users	Prior facility users	Present users
		Subsidy receiving users	Posterior facility users	Posterior facility users	Non-congested facility	Posterior facility users	Real estate buyer	Posterior facility users	Futures users
	Undertakings	Subsidy providing section	Prior facility	Prior facility	Congested facility	Congested facility	Transport facility section	Prior facility	Present facility
		Subsidy receiving section	Posterior facility	Posterior facility	Non-congested facility	Posterior facility	Real estate section	Posterior facility	Futures facility
Policy target for regulator			Equality in cost burden among different facilities	Equality in availability among different areas	Reduction of the number of bottleneck	Reduction of congestion	Internalization of development value	Optimal service level of a network	Equality in cost burden among different generations

Depending upon the situation and conditions of the cross subsidy scheme, different stakeholders such as users and transportation undertaking raise different concerns. It is very important for the long run sustainability of the transport facility to reach a consensus among these different interest groups on the basis of fairness and social efficiency. However, it is important to analyze the concerns of each party also in the light of their respective group interest (Table 1). In the following sections of this chapter, we will take a closer look on how cross subsidy is perceived among the different stakeholders of the

transportation system.

2.1 From the Users' View

The impact of most of the cross subsidy scheme, irrespective of them being inter-undertaking, inter-route, or inter-regional, is ultimately transferred to the users. In fact, if the same objective targeted by the cross subsidy was pursued by the general lump-sum taxation, the controversy might be at far low level as the mechanism of burden transfer from one user group to another is very indirect and less visible. As the burden transfer becomes so visible within the system of relatively small transport sector/network (some times only with couple of routes), it is very natural on the part of subsidy-providing group to oppose and, on the part of subsidy-receiving group to support the scheme. When cross subsidy is provided to posterior route to compensate the increased construction cost of posterior route, the users of prior route directly feel the burden transfer through increased fare. Likewise, in a little less directly, the urban resident will be reluctant to agree in the policy of making disproportionately high investment in rural road network from the special road account where their contribution is substantially high. On the other hand, if the subsidy receiving facility has a high degree of external benefits such as a bottleneck link of a network, most users may support the cross subsidy scheme (Shoji 1988).

It might sometimes be very difficult to find a common ground between the arguments of different user groups. Most complex issue in this regard could be how to judge a fairness of price level to be imposed to different users as a result of cross subsidy. Depending upon the underlying objectives of the transport facility, there might be many alternative criteria to judge the fairness in the fare level, such as fairness in terms service level provided, cost of service, income level of users or other social service-based criteria (Institute for Transport Policy Studies 1985). Each interest group might prefer to judge the fairness on the basis of different criterion which makes the debate virtually non-ending. However, open discussion among such different user groups might provide important information regarding the impact of cross subsidy scheme. By judging the degree of opposition or support along with the size of respective group, the overall impact of cross subsidy can be assessed.

2.2 From the Undertaking's View

As long as there is a possibility of profit reduction due to cross subsidy scheme, the transportation undertaking would not support cross subsidy scheme. In cases, where the posterior route generates additional demand for the network, the undertaking goes for cross subsidy scheme. But if the posterior route is to compete with the existing congested route, the undertaking will oppose the construction of such route, let alone provide cross subsidy. In such case, the undertaking's view conflicts with the social goal of reducing congestion and maintaining equality in fare level in two competing routes. Also if the construction of the new route creates other business opportunities such as housing and real estate, the undertaking would provide cross subsidies to construct the route (Sawada et al. 1991). That is if the new route brings net positive external benefit to the undertaking, it can be a candidate for cross subsidy and vice versa.

Profit constraints and uncertainties created by regulation are other concerns of the transport undertaking that make the undertaking hesitant to adopt cross subsidy approach. Particularly, some regulatory provisions (such as geographical jurisdiction of undertaking) discourage adoption of cross subsidy scheme for otherwise justifiable route. Likewise, if the profit earning department or route is exposed to the sever competition, it might be difficult for the undertaking to sustain cross subsidy scheme (Okuno 1989). The uncertainties in regulatory provision including the political intervention make the undertaking more vulnerable and reduce its capacity to adopt cross subsidy scheme. On the other hand, even in the case of good profit making condition, the undertaking would rarely prefer to serve the objective of social service or regional balance.

2.3 From the Regulator's View

Here the word 'regulator' covers public authority of different levels which is empowered to regulate in order to ensure fairness, efficiency and other social interests related to transport sector. Meeting all criteria simultaneously is almost impossible, so what the regulator has to do is, make trade-off between conflicting criteria weighing importance of each criteria at the given situation. For instance, the objective of inducing economic growth by supplying transport infrastructure (using cross subsidy) may receive higher weight during the takeoff and early growth stage of economy while economic efficiency (i.e. as strict user pay principle) may be more important when economy reaches mature stage and is open to international competition. In the institutional setup with in-built cross subsidy mechanism, there is a tendency of under-investment (due to lack of financial resources) in the early stage of growth while the later stage may witness a tendency of over-investment (due to abundant financial resources) (Ito 1992). To avoid such inefficiency in investment practice is also a major policy objective for the regulator.

In fact, while deciding on whether a transport infrastructure facility should subject to cross subsidy, the regulator compares the scheme with other alternatives such as independent profit scheme (with or without external-subsidy) and no provision of the facility. Here again the key criterion is the nature of external economic and social benefits of the proposed facility. If the external benefits (as defined on the basis of underlying objectives) are very diffused over all sectors and regions of the economy, only external subsidies from central government is justified and if it is confined to a particular local region, only external subsidies from local government is more justifiable. Likewise, if the proposed facility has insignificant external benefits and can not cover the cost of construction and operation by its toll or fare revenue, the regulator decides not to develop the facility. On the other hand, for a facility with a potential of high profitability but a significant negative external effects, the regulator brings it under cross subsidy scheme and makes it to subsidize other facilities that help reduce such negative effects (for example, the inter-modal cross subsidy between road and railway: railway help to minimize air pollution in urban area and hence deserves a cross subsidy from road users). Another concern of regulator is the political interference which often force them to deviate from the optimum path of regulation.

3. EMPIRICAL OBSERVATION ON CROSS SUBSIDY SCHEME

With the backdrop of above discussion, in this chapter, we first describe cross subsidy schemes in Japan along with a few examples of schemes without cross subsidy. We also mention the problems of cross subsidy scheme and propose guidelines to improve the effectiveness of the scheme.

3.1 Cross subsidy Scheme in Japan

As opposed to financing the transport infrastructure project from general tax revenue of central government, Japan has adopted the user-pay-principle (directly or indirectly) to recover the cost of infrastructure. But in practice, it has subjected to some kind of moderation through cross subsidy scheme to fulfill broader national objectives of transport sector. The mechanism of cross subsidy is however different in different schemes. Usually cross subsidy scheme has been introduced in combination with the external subsidy. The following schemes are counted among cross subsidy schemes in transportation infrastructure provision in Japan.

(1) Special financial account for road: Special financial account for road has been in existence since 1958. The scheme aimed at expediting construction and improvement of general roads. Basically, sources of this fund are fuel and car related tax (Inoue et al.

1991). Unlike in USA, where allocation of such fund among different states is based on the respective states' contribution to the revenue (over 90 percent of such fund must be sent back to the source-state), there is no any specific condition laid for allocating investment for different routes in Japan. Such a lack of constraint, gives government a flexibility to cross-subsidize backward regions at the burden of developed region. Local governments of urban areas like Tokyo and Osaka often argue that such cross subsidy system is unfair (Morisugi 1991). But, central government logic is based on the fact that the road network in developed regions is well developed (and metropolitan area has well developed toll road system generating additional source to finance expressways) and backward regions with inadequate road facility deserve subsidy (Toll Road Section of Road Council 1994-7).

(2) Toll pool scheme for National Development Arterial Expressways: For the national expressways network construction, Japan Highway Public Corporation (JH) was established in 1956. JH has constructed and improved the National Development Arterial Expressways and has adopted toll pool scheme in this network since 1972. Normally, if a proposed route can generate enough demand to recover at least 50 percent of the construction cost, the route qualifies to be undertaken by the scheme. This criterion is set to avoid any possibility of excessive burden-transfer to the prior route users. In case of the route which cannot meet this criterion but can be justified on the ground of the equality, a subsidy by the central government is given to bring the burden of annual capital cost[1] on the route at 3% (Japan Highway Public Corporation 1998).

(3) Toll pool scheme for Metropolitan Expressway: For the expressways network construction in Tokyo Metropolitan Area, Metropolitan Expressway Public Corporation was established in 1959. Metropolitan Expressway Public Corporation has constructed and improved expressways in Tokyo Metropolitan Area and the surrounding area. It has adopted differential toll by zones but a fiat toll in Tokyo (Inoue et al.1991, Toll Road Section of Road Council 1994-7).

(4) Toll pool scheme for Hanshin Expressway: For the expressways network construction from Osaka to Kobe, Hanshin Expressway Public Corporation was established in 1962. Hanshin Expressway Public Corporation has the same system as Metropolitan Expressway Public Corporation (Inoue et al.1991, Toll Road Section of Road Council 1994-7).

(5) Toll pool scheme for Honshu-Shikoku Toll Roads: These schemes covers three bridges connected between Honshu Island and Shikoku Island. For the construction and operation of these bridges, Honshu-Shikoku Bridge Authority was established in 1970. It is managing Seto-Chuo Expressway, Kobe-Awaji-Naruto Expressway and Nishi-Seto Expressway. The Authority has fixed the toll level to make total user's cost less than that when traveled using the ferry. Revenue from these three routes is pooled together and used to pay back the loan (Honshu-Shikoku Bridge Authority Economic Committee 1997).

(6) Toll pool scheme for Specified City Expressway: In case of inner city system of road transport, individual operation of toll roads may create problem due to uncoordinated toll system (due to the different schedule of toll road construction). Specified City Expressway Public Corporations were established in Nagoya, Kitakyusyu and Fukuoka to facilitate the development of well-coordinated urban expressway network in these cities. The public corporations have adopted uniform toll system to fully recover the construction cost and repay the debt (Inoue et al. 1991, Toll Road Section of Road Council 1994-7).

(7) Toll pool scheme for Other Toll Roads: JH has instituted these schemes to bring the functionally related routes (i.e. in some way acting as segments of a common network) but not covered by any other cross subsidy scheme. The conditions to be met by such routes are a) at least half of users should be common for both routes and, b) at least one half of the users switch when a route is free or impassable. One example of such scheme is the one involving Yokohama-Yokosuka road, Yokohama New-road, and The Third Keihin road (Toll Road Section of Road Council 1997).

(8) Special financial account for airport: Special financial account for airport has been in existence since 1970. The scheme aimed to expedite construction of airports to establish a

[1] Burden of annual capital cost on the route = (interest-subsidy by government)/(the balance of debt + the balance of equity by government)

nationwide network of air transport. Aircraft operation related fee, airport fee and aircraft fuel tax are the sources of this fund. Ministry of Transport administers this fund. All construction cost of the first type airport is covered by this fund, while only 75 percent and 50 percent of total construction is covered in the case of second and third type respectively (Kosaka et al. 1991).

Table 2 summarizes the key features of each scheme we have discussed above.

Table 2. Cross subsidy Scheme in Japan

	Name	Organizations	Underlying objectives	Financial resources	Targeting infrastructure
1	Special financial account for road	Ministry of Construction	To expedite construction of road Users-pay principle To facilitate financing	Fuel tax Car weight tax etc.	General road
2	Toll pool scheme for National Development Arterial Expressways	Japan Highway Public Corporation (JH)	Establishment of a nationwide expressways network Maintaining equality, service level and cost burden To facilitate financing	Uniform toll rate for National Development Arterial Expressways	Intercity network authorized by government Route whose revenue cover more than 50% of total cost Road with special purpose
3	Toll pool scheme for Metropolitan Expressway	Metropolitan Expressway Public Corporation	Equality in users' benefit Efficiency in toll collection To facilitate financing Balance of toll in the network	Differential toll by zones for Metropolitan Expressways	Urban expressway in Tokyo Metropolitan Area
4	Toll pool scheme for Hanshin Expressway	Hanshin Expressway Public Corporation	Equality in users' benefit Efficiency in toll collection To facilitate financing Balance of toll in the network	Differential toll by zones for Hanshin Expressways	Urban expressway in Osaka Metropolitan Area
5	Toll pool scheme for Honshu-Shikoku Toll Roads	Honshu-Shikoku Bridge Authority	Balance of toll between three bridges To facilitate financing	Toll less than user surplus comparing with ferry	Seto-Chuo Expressway Kobe-Awaji-Naruto Expressway Nishi-Seto Expressway
6	Toll pool scheme for Specified City Expressway	Ex. Nagoya City Expressway Public Corporation	Equality in users' benefit Efficiency in toll collection To facilitate financing Balance of toll in the network	Flat toll for Nagoya City Expressways	Urban expressway in Nagoya City
7	Toll pool scheme for Other Toll Roads	JH	Balance of toll rate between pooled roads To expedite construction of road	Each toll rate depended only satisfying zero profit constraint	Road that one half of users are common Road that one half of users switch when a route is free or impassable
8	Special financial account for airport	Ministry of Transport	To expedite construction of airport Establishment of a nationwide airport network	Airport charge & Airplane charge (in 1st and 2nd type airport.) Airplane fuel tax	100% of 1st type airport cost 75% of 2nd type airport cost 50% of 3rd type airport cost
9	Subsidy schemes for railway construction	Corporation for Advanced Transport and Technology	Securing financial resources construction in each rail Balance of construction cost with prior route	Income from Shinkansen transfer Subsidy from government	Construction and improvement of New Shinkansen Main arterial railway Urban railway Linear motor train development Safety and hazard reduction investment
10	Cross subsidy between routes of each railway undertaking	Ex. Teito Rapid Transit Authority	Efficiency in fare collection Reduction of risk from financing	Differential fare by zones for Teito Rapid subway network	Railway in the undertaking
11	Special City Railway Development Reserve Fund Plan	Private enterprises which operate railway in urban area	Reduction of congestion To expedite capacity expansion of a route Reduction of financial risk	10% raise on previous fare of the construction section	The section constructed within 10 years 50% of the construction cost

(9) Subsidy works for railway construction and improvement: There has been no Special financial account for railway in Japan because railway undertakings are either private enterprise, public corporation, the third sector or local government entity. Railway usually needs a large initial investment for which the flow of return may subject to some time lag. This makes the new expansion work unattractive especially for private sector. Railway Development Fund was established in 1991 to promote investment in socially justifiable railway projects. It mobilizes the financial resources generated as a result of privatization of Japan National Railway (JNR) to several Japan Railway Company (JR). Now the

organization name has been changed to Corporation for Advanced Transport and Technology and the organization works for new Shinkansen, main arterial railway and urban railway including subway construction and improvement (Sawada et al 1991).

(10) Cross subsidy between routes of a railway undertaking: In case a railway undertaking has plural routes as a network, the undertaking generally adopts a common fare scheme. Teito Rapid Transit Authority (TRTA), which has constructed and operated subway network in Special Wards Area in Tokyo Metropolitan Area, is an example of such case. The authority extends the network investing its revenue collected from the fare. While doing so, the posterior route would automatically receive cross subsidy (Teito Rapid Transit Authority 1997).

(11) Special City Railway Development Reserve Fund Plan: Though it was necessary to expand the capacity of commuting railway in major metropolitan areas, the railway undertakings had a little incentive to go for expansion (as profit is higher when operated under congestion). Special City Railway Development Reserve Fund Plan (SCRDRFP) was established in 1986 as an incentive scheme. According to this scheme, the private railway company is allowed to raise the fare up to 10 percent to finance up to 50 percent of the construction cost of the network expansion. But such fare rise is allowed only for 10 years before opening of the expanded facility. This revenue can be deposited as a tax-free. After the project finishes, the company must return the balance, if any, by charging low fare (Yoda 1998).

3.2 Problematic Examples of Schemes without Cross subsidy in Japan

There are several opinions related to the cross subsidies as mentioned before. What follows are examples of a few transportation infrastructure undertakings which were instituted as independent entities without cross subsidy provision.

(1) Tokyo-wan Aqua-line: The highway-tunnel and bridge across the Tokyo Bay named as Tokyo-wan Aqua-line was opened in 1997 for the purpose of reducing congestion on Tokyo urban road network. This route has been constructed and operated by a semi-public corporation. Though the route forms a link of a larger JH network of arterial roads, because of the relatively high cost of construction, it was decided to construct and operate it under an independent undertaking. The logic behind this arrangement was that the high cost should be born by the users of the route rather than distributing it over all users of national JH network. The result of this institutional arrangement however is not encouraging. The toll rate is too high (4,000 yen for 15 km) as compared to JH rate (about 500 yen for 15 km). The actual demand (15,000 vehicle/day) is far less than the revised estimated demand (25,000 vehicle/day). Thus, the facility is running under-capacity while other parallel routes experience severe congestion.

(2) Ken-ou Expressway, Tokyo Gaikan Expressway and Tokyo Metropolitan Expressway: Ken-ou Expressway and Tokyo Gaikan Expressway in Tokyo Metropolitan Area are segments of outer and middle ring road respectively. These two ring-roads were planned to reduce the congestion of metropolitan expressways in Tokyo by diverting the through traffic of metropolitan expressways. Both of these segments were constructed by JH. While the middle ring-road is a part of the national network of National Development Arterial Expressway, the outer ring-road is an independent toll road scheme undertaken by JH. So middle ring-road can receive subsidies from nationwide JH network and Metropolitan Expressway from it's own network. But outer ring-road has to stand on it's own without provision of any cross subsidies. Therefore, toll rates are different in these three routes. Actually, the toll rate of Metropolitan Expressway will be lowest and that of outer ring-road will be the highest when the construction will be complete. As a result, the transfer of through traffic to ring-roads from metropolitan expressway may not be at the expected level. We can see that if these closely related three routes were subject to some kind of cross subsidies mechanism, the total system would have been much effective.

(3) Special financial account for port: Special financial account for port was established 1961. The scheme aimed at expediting the construction of port. But financial resources of

the fund come mostly from general fund. The fee is however not pooled. Therefore, revenue from ports in urban area cannot be transferred to construct port in rural area. Marine transportation has a characteristic needing one origin port and one destination port. So if a new port is constructed, other ports may get some benefit from the new port. But, according to the current provisions of special financial account for port, the positive spillover effect can not be compensated through cross subsidy (Eto et al. 1991, Ministry of Transport 1996).

(4) Toyo Kosoku Line: Toyo Kosoku Line was planned for the purpose of reducing congestion in a private line (Keisei Line) running between Tokyo and a neighboring prefecture (Chiba). It was constructed in 1996 as an extension (falling in Chiba Prefecture) of existing subway line of Teito Rapid Transit Authority (TRTA), which is one of the subway network in Tokyo Prefecture. As TRTA was capitalized by the central government and Tokyo Prefecture government, its geographical jurisdiction has been confined to Tokyo Prefecture only. Because of this regulatory constraint, TRTA was not allowed to construct and operate the line even though it was the extension of one of TRTA lines. Therefore, Chiba prefecture government had to establish a separate public corporation named Toyo Kosoku Railway Corporation to construct and operate this line. Because of the high cost of construction, fare was extremely high (610 yen) as compared to the existing fare level (310 yen) of the private line. As a result, the transfer of demand from the congested private line to the new line remained far below the expected level. Thus, because of the low level of independent profitability (causing high fare as well as financial difficulties) of the new line, the intended objective has not been met. But the construction of the line was well justified, as the private railway company (Keisei line), which was operating under congestion, did not want to construct another competitive line. On the other hand, if TRTA was allowed to expand its network by itself using its own cross subsidies mechanism and subsidy from Chiba Prefecture (same as Toyo line has received), the total system might have been better for both stakeholders, the Chiba Prefecture and users.

3.3 The Problems of Cross subsidy Scheme

While in theoretical discussion, the cross subsidy scheme can be well justified in transport infrastructure provision. But there are some practical problems in operational level. In the following paragraphs, we have categorized and discussed these problems under different headings.

Table 3. Underlying Objectives of Selected Each Cross subsidy Schemes

		Various special financial accounts	Toll poo! scheme National Development Arterial Expressways	Toll pool scheme for urban Expressways	Toll pool scheme for Honshu-Shikoku Toll Roads	Subsidy schemes for railway construction	Cross subsidy between routes of each railway undertaking	SCRDRFP
1	Equality in users' benefit	○	○	○	○	○		
2	Getting rid of bottleneck			○			○	○
3	Minimization of risk	○	○	○	○	○	○	○
4	Expedite economic growth	○	○	○				○

(1) Problems in selecting underlying objectives: Table 3 gives an example showing how different cross subsidy schemes varies in terms of underlying objective. Such a varied set of underlying objectives in different infrastructure provisions invites endless debates about the desirability and effectiveness of cross subsidies as the sensitiveness of different stakeholders to different objectives is not the same. For example, the cross subsidy scheme in road construction has an objective to ensure equality in users' benefit but the concept of equality is not very clear and it can be legitimately argued that the scheme produces excessive facilities. While the burden-transfer from one interest group to another may not

be so directly visible in the case of policy intervention through imposing general tax, the same through cross subsidies would be more visible and invites controversies. It is therefore necessary to devise and standardize objective criteria for each type of infrastructure provision while setting the underlying objectives.

(2) Problems in instituting the cross subsidies system: Identifying and setting up of an right kind of institution with appropriate sectional/modal as well as geographical authority to effectively implement cross subsidies scheme is a very challenging task in the first place. Another equally important issue is how to decide on route selection to form a system of cross subsidies. As we discussed before, exclusion of some routes from the cross subsidies scheme might undermine the original objective of route construction while inclusion of some otherwise unfeasible routes might cause inefficient investment. Also, there might be some possibility of over use (rather misuse) of cross subsidy scheme where public authority develop a temptation to compel transport undertakings to adopt cross subsidy even when the objectives can be met thorough competitive market mechanism. So, while instituting any cross subsidies scheme, a careful and detail objective assessment need to be done to ensure that provisions are correctly set.

In case of toll pool scheme for Other Toll Roads, the routes to be included into a subsidy scheme are subjected to a set of criteria. In case of toll pool scheme for National Development Arterial Expressways, Ministry of Construction decides the routes. But, in case of private railway company, individual companies decide the routes by themselves. Thus, the logic for selecting routes in different modes/undertakings is not uniform.

(3) From the constraints or conditionalities of cross subsidy scheme: As we discussed before, there is always a possibility of misuse of cross subsidy scheme resulting in a net social inefficiency. So, in some schemes, constraints and conditions have been imposed to ensure appropriate use of the scheme, such as shown in Table 4.

Table 4. Constraints on the Extension of Cross subsidy Range

	Kinds of constraint		Example	
1	Target limitation		Other Toll Roads SCRDRFP	functional relation with each other operation income from the construction section
2	Term limitation		Special financial accounts SCRDRFP	to decide allocation every 5 years construction within 10 years
3	Maximum level of subsidy			
		for provider	National Development Arterial Expressways	the amount limitation of cross subsidy: 50% of the total repayment cost
		for receiver	SCRDRFP	10% raise on previous fare
4	Consensus among interested parties		Subsidy works for railway construction	to get JR and local people agreement

Here, we can imagine possible problems in practice. Such as constraint 1 intends to limit the cross subsidy scheme only within the functionally related facilities. However, such qualitative constraint is not always enough to avoid the use of cross subsidy in a wasteful investment. On the other hand, constraints imposed on the extension of existing route might prevent efficient use of cross subsidy. Constraints 2, 3, and 4 have been imposed only selectively. Though there are constraints for a maximum level of subsidy for receiver, that for a provider is often lacking. In addition, the present evaluations of cross subsidy coverage often ignore the importance of efficiency at the network level. Also, there is no system of periodic review to adjust these constraints as the situation changes over time. Most importantly, to ensure efficiency and fairness, each cross subsidy scheme is required to obtain a consensus among various interest groups while setting up constraints. However,

the discussion is not transparent and open to public.

(4) From the reduction of the load to prior route users' payment view: As a result of cross subsidy, sometimes there might be high burden to prior route users, and hence there might be a need of some countermeasures to reduce such an excessive burden. Therefore, often cross subsidy and external subsidy should be combined together, and purpose of external subsidy should be to moderate cost burden for each tax payer and user group. The external subsidies may also act as an incentive to the transport undertaking to make investment with in-built cross subsidy scheme. Table 5 illustrates some of the counter measures adopted to moderate the excessive burden of subsidy providing users or routes.

Table 5. Reduction of the Load by Cross subsidy of Prior Route Users' Payment

	Kinds of reduction	Example	
1	Target limitation	Special financial accounts	subsidy rate difference according to the facility
2	With external subsidy	National Development Arterial Expressways Metropolitan Expressway	3% of interst subsidy in capital cost investment by Metropolitan government
3	Repayment term extension	National Development Arterial Expressways Metropolitan Expressway	from 30 years to 40 years
4	Time control of the amount of repayment	Subsidy schemes for railway construction	equal repayment of principal and interest
5	Fair additional investment to prior route	SCRDRFP	to improve the service level of prior line

3.4 Examining the effectiveness of cross subsidy in a toll road through simulation

In this section we examine a hypothetical case showing the effectiveness of cross subsidy scheme in serving various underlying objectives simultaneously. A route layout as shown in Figure 2 is considered where the ordinary road (without toll) and prior toll road are operating under congestion and a posterior road has been planned. The targeted objectives are to obtain repayment period of less than 30 years (financial feasibility), to maintain equality in toll rate (equity objective) and to minimize the total generalized cost per vehicle (efficiency objective). The total demand in this O-D pair, time assignment of the demand, maintenance cost and interest rate of borrowing are given. Traffic demand on each road for a given toll rate is forecasted using the traffic assignment model adopted by Metropolitan Expressway Public Corporation (MEPC). In computing the total generalized cost, a money term time value of 66.2yen/vehicle/min (as recommended by MEPC) is used. And social discount rate is taken as 4 percent.

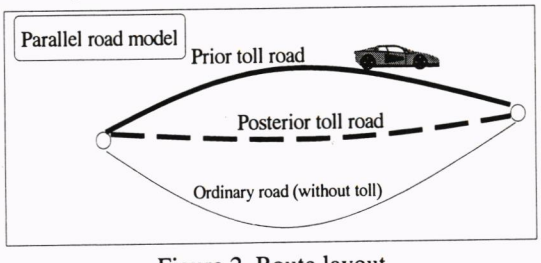

Figure 2. Route layout

Through simulation, three possible scenarios are considered, namely a) without construction of posterior road b) with non cross-subsidized posterior road and c) with cross-subsidized posterior road. Figure 3 shows repayment period of posterior road for different combination of toll rate in prior toll road and posterior road. A toll rate of 200 yen is the base toll rate in prior road and does not involve cross subsidy and for toll rate more

than 200 yen in prior road, the additional revenue generated goes for subsidizing posterior road. In case of no cross subsidy, the toll rate to be charged in posterior road is 1000 yen, that is 5 times higher than in prior road. This is a case of socially unjustified. But, when the toll rate in prior road is increased to 300 yen and the additional revenue generated to cross-subsidize the construction cost of the posterior road, the indicated toll rate in posterior road is 500 yen, where 25% of construction cost is cross-subsidized. This is more reasonable from social equity viewpoint.

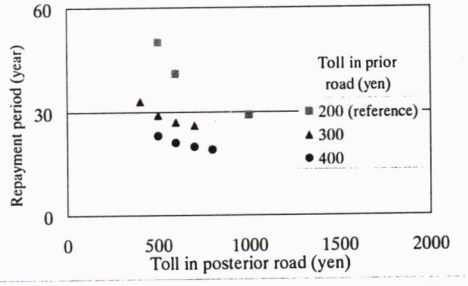

Figure 3. Repayment period of posterior road for different toll combination in prior and posterior road

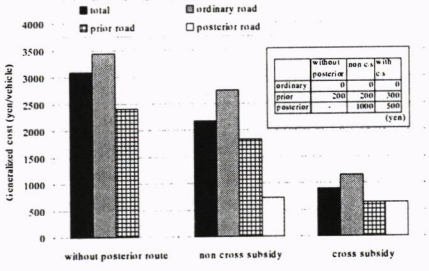

Figure 4. Total generalized cost in each case

Figure 4 shows the total generalized cost under different scenarios. In case that posterior road is not constructed, the cost is higher mainly due to time cost of congestion. When posterior road is constructed and operated without cross subsidy (i.e. with toll rate 1000 yen), the road will attract some traffic but not enough to relieve congestion of prior road completely. That is why, the generalized cost in prior road is more than that in posterior road despite low toll rate in prior road. Nonetheless, the generalized cost is less than the previous case. If cross-subsidy is introduced, there is a significant reduction in total generalized cost. Thus, the introduction of cross subsidy can enhance efficiency in terms of minimizing the total generalized cost.

With this simulation exercise, we can confirm that the effectiveness of cross subsidy in various objectives (such as financial, equity and efficiency) selectively or simultaneously.

3.5 Broader guidelines for effective application cross subsidy scheme

With the backdrop of above discussion, we make an attempt to present a summary of broad guidelines to be followed while applying cross subsidy scheme in a transport infrastructure provision. First, while instituting a transport infrastructure undertaking, attention should be paid to provide an appropriate geographical and sectional/modal jurisdictions not only from administrative view point but also from functional inter-relatedness of transport facilities. Second, we must decide whether a particular transportation facility deserves to be subject to cross subsidy scheme (the scheme may be cross subsidy provider or receiver). As discussed before, the crude criteria for this may be the degree of external effects the facility may produce and functional interrelationship of facility with larger network or other facilities. But, if the facility with a great degree of positive external effects can be well operated under market mechanism without subsidies, it should not supported by cross subsidy scheme. Besides, the stated objective of the transport facility should also be considered. For instance, if the facility is justified on the ground of social service rather than commercial profit, it might be a candidate for cross subsidy even with lesser degree of external benefits. Finally, a more detailed and objective evaluation should be carried out while setting terms and conditions of cross subsidy schemes for a particular transport

infrastructure facility. To the extent possible, such an evaluation process should be carried periodically to make adjustment with respect to changing condition, and most importantly, be open to all stakeholders to ensure fairness and efficiency and thereby effective use of cross subsidy scheme.

4. VIABILITY OF CROSS SUBSIDY SCHEME IN PRIVATE SECTOR

Because of increasing pressure on government budgetary system and potential of private sector for efficient investment and operation, involvement of private sector for social infrastructure project has recently been emphasized. Build-Operate-Transfer (BOT), BOO, BOL and other similar schemes have been adopted. Basically projects under these schemes operates independently. However, cross subsidy scheme is desirable to expand and/or establish a complete network (Miyamoto 1996). There are cases in which introduction of cross subsidy mechanism has effectively worked in BOT scheme. Such as in the urban expressway network of Bangkok in Thailand, the first stage expressway was constructed by public undertaking and the toll rate was 15 Baht. For the second stage segment of the network, private sector was involved under BOT scheme. This segment had a demand increasing effect on the first stage expressway. But if it were operated as an independent profit system, the toll would have to be fixed at much higher level because of high cost of construction. So, an arrangement was made to cross-subsidize the second stage by fixing a common toll rate of 30 Baht for both segments. This implies that, there is a scope of adopting cross subsidy scheme even in schemes with private sector's involvement. In the following paragraphs we discuss different institutional schemes to introduce cross subsidy into BOT and other similar projects.

4.1 Transportation Infrastructure Scheme with Private-sector Capital in Japan

In this section, a few schemes are discussed to show that participation of private sector is possible even without BOT scheme. There is a growing interest in Japan to promote such private sector involvement in transport infrastructure financing, operation and management under an umbrella concept of Private-Financing Initiative (PFI).

(1) Public corporation scheme: In Japan, the public corporation schemes (undertakings owned by public sector) in transport sector involve a use of private capital. Basically, the public corporations borrow the money from public and private banks. Also, central and/or local government provide capital subsidies for each project. The public corporation constructs the infrastructure and operates the facility under cost-recovery principle charging the users to payback the bank loans. A long payback period due to the long economic life of infrastructure makes private banks reluctant to lend private sector for infrastructure investment. But, government guarantee in case of public corporation makes the private bank lending possible due to reduced risk (Japan Highway Public Corporation 1998). This is the reason why public corporations are dominant in transport infrastructure sector.

(2) The third sector scheme: In general, the operation under a public corporation is not so efficient comparing to that under private sector. So the third sector, which means a partnership between public and private sector, has been instituted to develop and operate transportation infrastructure (Naruse 1997). Few examples of third sector include Trans Tokyo Bay Highway Corporation, Kansai International Airport Companies and many Automated Guideway Transit (AGT) undertakings operating in urban areas. In these schemes, the participation of private sector does not confined only to lending capital (as in public corporation) but also partially owning the facilities and thus they have a visible role to play in the mode of development, operation and management. This kind of partnership is expected to make use of private sector's entrepreneurial skills to enhance efficiency on one hand, and to meet objective of social efficiency (due to participation of public sector) on the other (Miyaki 1997).

(3) Private railway company scheme: Historically many private railway companies constructed and operated railway by themselves because they were profitable until automobile kept high modal share in Japan. Even after motorization, the private railway companies in major metropolitan areas have enjoyed their profitability of railway business and developed many kind of business like housing, real estate, developer business, construction, consultant, department store, super-market, leisure business, cable TV, hospital, schools and so on. Through these additional businesses, the railway companies have internalized the otherwise external economic benefits of railway service. Concentration of population in the metropolitan areas from 1960s caused a serious congestion on the urban railway lines and, on the other hand, reduced the profitability of railway in rural areas due to decreased demand. Therefore, the government established a system of construction subsidies for urban railway operators to give an incentive for the investment in rural area to increase the capacity, along with a system of operation cost subsidies for rural area railways to keep their service (Sawada et al. 1991). The urban railway operators invest for the expansion of their network and capacity by private loan, cross subsidy from their existing lines and external subsidies from the central and local governments (Yoda 1998). In the case that no private company is willing to construct the urban railway, the local government construct the subway or monorail, AGT, LRT receiving the subsidies from central government.

4.2 The Application of Cross subsidy to BOT

The BOT and similar schemes (BOO, BLO etc.) have been adopted for transportation infrastructure from 1980. The main purposes of such schemes were a) to provide infrastructure with a lesser burden on government budgetary system and, b) to maintain a higher efficiency in construction and operation of infrastructure facility by utilizing private sector's creativity and management skills (Doi 1995). However, when implemented, BOT schemes are not free of problems. In the absence of well designed institutional system, BOT scheme may result in serious problems as there is always a conflict between social optimization and private sector optimization. Some of the common problems with BOT scheme includes,

(a) the delay of project
(b) lack of co-ordination between different projects
(c) long-term inefficiency by keeping short-term optimization

Another problem is difficulty to introduce cross subsidy scheme into BOT, because BOT basically means independent project contract. Therefore, if cross subsidy scheme is necessary in future, some special consideration for BOT contract is essential. In general, consortium or one private company commits BOT project expecting fixed payback period and return. If cross subsidy scheme is introduced, the BOT may need longer payback period to recover cost. In this section, we discuss the possibility of cross subsidy scheme for BOT projects.

(1) Before the transfer of BOT infrastructure: If the government wants to bring the BOT project under cross subsidy scheme before the transfer, agreement with BOT company is necessary. In the case that the route to be cross-subsidized brings additional profits due to the increased demand, BOT company may be interested to provide cross subsidy. Even in the absence of such demand increasing effect, there might be other two possible scenarios. First, if there is a high profitability of BOT project requiring government to regulate the profit level (usually profit is regulated on the basis of agreed level of the Rate of Return on Equity (ROE) or price control), government can reach an agreement with BOT company to relax the constraint and use the additional revenue generated through such relaxation for cross subsidy. Second, if the profit level is normal, government may offer to extend the BOT tenure or allow raising the toll rate (this works only when demand is inelastic) and ask the BOT project to provide cross subsidy.

(2) After the transfer of BOT infrastructure: After the transfer of the infrastructure from private sector to the government, the government can bring the route under the cross subsidy scheme to subsidize other routes, if necessary. For this purpose government may choose one the following options:

(a) Continue users' charge for the governmental asset: If the government wants to subsidize other projects by the revenue of transferred asset, the law or rule to continue the users' charge should be first discussed and accepted by the public.
(b) Continue the operation under BOT company with lease: If the government contracts with BOT company to continue operation charging a lease fee, the government can use revenue from the lease to cross-subsidize other projects. The lease fee and term should be decided by the consideration of level of users' charge, profit of private sector and necessary fund for cross subsidy.
(c) Sale the governmental asset: Transferred infrastructure can be sold to private sector again and the revenue can be used for financial resources for other projects.

5. CONCLUSIONS

In economic literature, cross subsidy is often criticized as a source of economic inefficiency. Role of cross subsidy in transport sector, however, needs to be evaluated in the context of various socio-economic objectives. The objectives of cross subsidy scheme in transport sector cover a broad range such as from efficiency to equity or from urban to rural. It is too complex to analyze the cross subsidy in transport sector simply on the basis of economic textbook logic. Therefore, various transport undertakings instituted to develop and operate transport infrastructure in Japan with an in-built mechanism of cross subsidy. Hence we reviewed to appraise the role of cross subsidy. Then we examine a hypothetical case showing the effectiveness of cross subsidy scheme in serving various underlying objectives simultaneously. By analyzing the cases of the cross subsidy scheme in totality, the positive role of cross subsidy scheme became more visible, particularly in generating financial resources when government budgetary system is highly stressed during takeoff stage and early rapid growth stage. Likewise, the scheme, to the large extent, has help to moderate the disparity between growing regions and backward regions. We thus confirmed that the cross subsidy can be effective in fulfilling various objectives (such as financial, equity and efficiency) selectively or simultaneously. This observation however should not be interpreted that cross subsidy scheme is fault-proof and always deliver positive results. It is very challenging task to make a judicious use of cross subsidy scheme by maintaining a delicate balance between fairness, efficiency, and equity.

One of the problems now common in developing countries is severe lack of financial resources to invest in infrastructure. The experience of Japan in developing and operating transport infrastructure through the use of cross subsidy should certainly offer a useful lesson for developing countries. Though there is a new trend of private sector participation in infrastructure financing and development, the relevance of cross subsidy is still there as not all objectives served by cross subsidy can be taken care of by private sector. A serious attention should be paid to devise an institutional framework that facilitates the inclusion of cross subsidies scheme into private sector's infrastructure projects such as BOT.

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